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ABSTRACT

This curriculum guide is designed to assist bricklaying instructors in providing performance-based instruction in advanced bricklaying. Included in the first section of the guide are units on customized or architectural masonry units; glass block; sills, lintels, and copings; and control (expansion) joints. The next two units deal with cut, ashlar, and rough stone. Covered next are various types of panels and veneers, including precast and prefabricated units; stone, slate, marble, and granite panels; and wall and floor tile. The final two units deal with cleaning, pointing, and caulking; and moisture control and waterproofing. Each instructional unit contains performance objectives, suggested activities, information sheets, job sheets, tests, and answers to the tests. (MN)

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bricklaying curriculum: advanced bricklaying techniques

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Bricklaying Curriculum
Advanced Bricklaying Techniques

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Curriculum and Instructional Materials Center

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BRICKLAYING CURRICULUM
ADVANCED BRICKLAYING TECHNIQUES

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FOREWORD

In 1975 the Associated General Contractors of America met with representatives of the Oklahoma Curriculum and Instructional Materials Center to discuss the possibility of developing, as a cooperative project, a course of instruction designed for training bricklayers who will make their careers in industrial and commercial construction.

This publication is the result of that discussion. It is the product of close coordination among general contractors, bricklayers, and vocational/technical educators. This manual represents a conscious effort to meld the practical experience of those in the construction industry with the expertise of those in the field of vocational education.

The trainers of skilled construction workers are faced with the challenge of providing thorough and modern training to the backbone of the construction industry, its work force. The purpose of this manual is to assist bricklayer instructors in providing a high-caliber instructional program. In 1982 AGC and CIMC decided that there was a need to update this manual in order to keep up with the everchanging materials, skills, techniques, and demands of the profession. Therefore, we have revised this manual with these changes in mind. Although the format reflects a systematic approach to instructional materials development and the latest in educational technology innovations, the information in *Bricklaying Curriculum: Advanced Bricklaying Techniques* should be adapted and modified to coincide with local conditions. To make the training process complete, the materials should be coupled with the instructor's own methods and experience, and supplemented with additional materials.

Dr. Francis T. Tuttle, Director
Oklahoma State Department of
Vocational and Technical Education

Robert B. Fay, Chairman
Manpower and Training Committee
Associated General Contractors of America

PREFACE

For many years contractors and those responsible for training bricklayers felt the need for instructional materials to be used in the training. In 1977 the Associated General Contractors of America, with the cooperation and support of the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, accepted the challenge to produce a manual for use in training bricklayers in those areas in which they are expected to be proficient.

Instructional material in this manual is written in terms of student performance, using measurable behavioral objectives. This is an innovative approach to teaching that accents and augments the teaching/learning process. Criterion-referenced evaluation instruments provide for a uniform measurement of student progress.

Bricklayer instructors are faced with the challenge of providing students with the skill and related information necessary to meet the demands of a changing profession. Competition for jobs is greater than ever. Therefore, the bricklayer must be better trained and better equipped to find and retain meaningful employment. This is why AGC and CIMC felt a need to revise and update this manual.

The purpose of this manual is to assist bricklayer instructors in providing instruction throughout the industry. This publication should be supplemented by each instructor's methods and materials. Any information in this manual that does not concur with the instructor's course of study can be modified to meet personal needs.

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We are grateful to the following individuals and companies for their technical support during the development of this manual.

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There is much work that goes into the making of a manual, and there are many people behind the scenes who make a publication possible. Special appreciation is extended to Dona Landreth, Gari Sha Robinson, Rose Primeaux, and Allison McLaughlin, staff members in the Word Processing Center, for making sure that the final typed copies are of the highest quality. The artwork in this book also deserves special commendation. Special thanks to artists Regina Beaney, Gary Bradley, Kim Hale, Kathryn Hansen, Nancy Hilley, and Carrie Williams for their drawings.

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Laborn J. "Bud" Hendrix, AGC-CIMC Writer
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USE OF THIS PUBLICATION

Instructional Units

Bricklaying Curriculum: Advanced Bricklaying Techniques contains four sections and eleven instructional units. A standard format was established in 1970 for development of instructional materials for all Oklahoma vocational teachers. This format includes eight basic components that form a unit of instruction: performance objectives, suggested activities for the instructor, information sheets, assignment sheets, job sheets, transparency masters, tests, and answers to tests and assignment sheets. Depending on the specific objectives, there may or may not be transparency masters, assignment sheets, and job sheets included in the unit of instruction.

All of the unit components "zero in" on measurable and observable learning outcomes. Instructors are encouraged to supplement, personalize, localize, and motivate with these materials in order to develop a complete teaching/learning process.

Units of instruction are designed for use in more than one lesson or class period of instruction. Careful study of each unit of instruction by the instructor will help him or her determine the following

A. Amount of material that can be covered in each class period
B. Skills that must be demonstrated
    1. Supplies and equipment needed
    2. Amount of practice needed
    3. Amount of class time needed for demonstrations
C. Supplementary materials, such as pamphlets and filmstrips, that must be ordered
D. Resource people who must be contacted

Performance Objectives (white pages)

Each unit of instruction is based on the performance needed for successful employment in an occupational area. Performance objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction; and specific objectives, stating the performance necessary to reach the unit objective.

Since the objectives of the unit provide direction for the teaching/learning process, it is important that instructors and students have a common understanding of the intent of the objectives. Following is a list of performance terms, their meanings, and behavioral synonyms that may have been used in this material.

A. Name — The individual supplies a name for objects, events, or people

Behavioral synonyms: Label, list, letter, record, reiterate, repeat, write

B. Identify — The individual selects a named, described, or pictured object by pointing to it, touching it, picking it up, or selecting it

Behavioral synonyms: Select, mark, match, choose, judge

C. State a rule — The individual communicates a relationship or principle that could be used to solve problems or perform a task

D. Apply a rule — The individual supplies an answer to a problem by using a stated relationship or principle

Behavioral synonyms: Solve, calculate

E. Describe — The individual relates sufficient characteristics or properties of an object or event so that a second individual will be able to state what is being discussed

Behavioral synonyms: Define, discuss, interpret, recite, tell how, tell what happens when

F. Distinguish — The individual selects an object or event from two or more that are easily confused

Behavioral synonyms: Discriminate, differentiate

G. Order — The individual arranges three or more objects or events in a sequence based on a stated property

Behavioral synonyms: Arrange, sequence, list in order, classify, divide, isolate, sort

H. Construct — The individual makes a physical object, a verbal statement, or a drawing

(NOTE: *Construct* is used when the finished product or result is important.)

Behavioral synonyms: Draw, make, build, design, formulate, reproduce, transcribe, convert, put together, compile

I. Demonstrate — The individual performs several operations necessary to carry out a specified process

(NOTE: *Demonstrate* is used when it is desirable to watch the student perform a task, one of the highest levels of student performance.)

Behavioral synonyms: Show your work, show procedure, perform an experiment, perform the steps, operate, remove, replace, turn off/on, (dis)assemble, (dis)connect

The objectives should be provided for students and stressed throughout the teaching/learning process. This will help answer any questions concerning performance requirements for each instructional unit. The objectives can also help determine teaching strategies and instructional methods. Prepare for each unit by deciding how each objective can best be taught.

The objective sheet may also be used as a quick pretest to determine prior knowledge of students and to determine whether further study or activities are necessary. Instructors should feel free to modify, delete, or add objectives in order to meet the needs of the students and community. When changes in objectives are made, the instructor should remember to supply the needed information, assignment and/or job sheets, and criterion test items.

Suggested Activities (pink pages)

This component is included only in instructor material. The suggested activities page assists the instructor during the preparation stage of the teaching/learning process by providing suggestions for delivery and/or presentation during the instructional process. Read the suggested activities before teaching the units so that supplemental materials can be obtained, audiovisual materials prepared, and outside resources contacted. Duties of the instructor will vary according to the particular unit.

The references that are listed are ones used in the development of each unit. They should be used by the instructor to supplement her or his knowledge of the subject area or to help students with particular interests or occupational objectives in the area covered.

Information Sheet (green pages)

The information sheet provides "must know" content essential for meeting the cognitive (knowledge level) objectives of the unit. The information is written in a topical outline form and is keyed to the specific objectives.

Instructors will find that the information sheet serves as an excellent guide for presenting background knowledge necessary to develop the skills specified in the unit objective. The information sheet may also be used for coordination activities and advisory committees.

Students should read the information sheet before the information is discussed in class. Space is provided in margins for students and instructors to add notes that supplement, localize, personalize, or provide motivation for each unit.

Transparency Masters (white pages in instructor material and green in student material)

Transparency masters provide information in a special way. Transparencies direct the class's attention to the topic of discussion. Transparencies may present new information, or they may reinforce information presented in the information sheet. They are particularly effective when identification is necessary. Make transparencies and place them in the notebook where they will be immediately available for use.

Assignment Sheets (brown pages)

Assignment sheets give students a chance at problem solving, self-assessment, and/or practical experience with the information. They assist students in the application of knowledges that are necessary prerequisites to skill development These may be given to the student for completion in class or used for homework assignments. Answer sheets are provided when appropriate and can be used by the student and/or instructor for checking student progress.

Job Sheets (blue pages)

Job sheets are another important segment of a unit of instruction. The job sheets provide a list of equipment, tools, and materials needed to complete a manipulative or psychomoter skill. They describe a step-by-step procedure needed to complete each task or job. Diagrams, photographs, and illustrations are provided to assist students in achieving the skill.

Instruments in job sheets are not in order of use. The order of use should be taught in the classroom. In this way, students will not depend entirely on job sheets for instrument setup.

Instructor should demonstrate to students the procedures outlined in each job sheet. Furthermore, the instructor needs to localize the job sheet according to the equipment and supplies available in the local lab or shop situation. Job sheets also furnish potential employers with a picture of the skills being taught and the performances they might reasonably expect from a person who has had this vocational instruction.

Tests (yellow pages)

This component provides criterion-referenced evaluation of every objective listed in the unit of instruction. It is crucial to note that both paper/pencil and performance objectives must be evaluated.

The tests may be written or oral. It is recommended that the tests be divided into shorter tests covering three or four objectives at a time and given soon after those objectives have been covered. A selection of questions from the units covered may be used for final tests at the end of each term if desired. If objectives have been added, deleted, or modified, be sure to make the changes on the test.

The acceptable response on a unit test, 85 percent in most units, may be raised or lowered to fit the topic or students' ability levels. The percentage applies to the overall score, not to each individual question. The final unit grade should be obtained by using the paper/pencil score along with evaluations of student demonstrations of the desired skills.

Answers to Test and Assignment Sheets (pink pages)

These components are designed to assist the instructor in evaluation of student performances.

Page Numbering

Each publication from the Curriculum and Instructional Materials Center is assigned a specific abbreviation. For example, *Bricklaying Curriculum: Advanced Bricklaying Techniques* has been abbreviated ABL. The units are then numbered consecutively within each section. An example of a page number is ABL-1-A. Since CIMC publications are loose leaf, this system of page numbering was adopted so that pages from different manuals would not get mixed up.

Methods of Disseminating Material

Material may be given out a unit or page at a time to keep the material before the student always new. Some instructors ask students to furnish a three-ring binder for the units. This is convenient for taking the materials home to study. Upon completion, each unit is then placed in a larger binder. The large binders may be purchased at cost from the CIMC. Some instructors store the materials by units in filing cabinets or boxes until needed. All the units may be given out at once if desired.

For best results, provide student materials for each student. Student materials contain everything but the test answers, answers to assignment sheets, and suggested activities. All tests are collated at the back of student material and should be removed and stored until needed. Students should be allowed to take their materials home at the end of the year.

Teaching Methods

It is a challenge to keep students motivated. Supplement the objectives by providing the "why," personal experiences, and current information. Prepare for each unit by deciding how each objective can best be taught. Allow students to become involved in preparing and planning.

Competency Profiles

Competency profiles are folders used to document student performance. The profile contains a list of the specific job competencies that should be achieved prior to leaving the training program.

CUSTOMIZED OR ARCHITECTURAL MASONRY UNITS
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to identify various types of customized or architectural masonry units and use customized or architectural units to construct different types of walls. The student will show this knowledge by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with customized or architectural masonry units to their correct definitions.
2. Describe slump block, split-face block, and adobe block.
3. Identify types of customized or architectural masonry units.
4. State ways types of block are distinguished from each other.
5. State characteristics of masonry units.
6. Match specifications of some masonry units to their ASTM designations.
7. State factors to consider before using customized or architectural masonry units.
8. State main factors for determining where a unit should be used.
9. Arrange in order the procedures for setting slump block, split-face block, and adobe block.
10. Demonstrate the ability to
    a. Construct a garden wall with screen or grill block, using mortarless joints.
    b. Construct a partition wall with fluted or sculptured block, using mortarless joints.
    c. Construct a section of wall, using slump block.

CUSTOMIZED OR ARCHITECTURAL MASONRY UNITS
UNIT I

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Provide students with objective sheet.

   B. Discuss unit and specific objectives.

   C. Provide students with information and job sheets.

   D. Discuss information sheet.

   E. Gather equipment and materials for job sheet demonstrations.

   F. Demonstrate and discuss procedures outlined in job sheets.

   G. Provide students with specifications, job plans, and methods to complete procedures outlined in job sheets.

   H. Give test.

   I. Complete appropriate section of competency profiles.

   (NOTE: Competency profiles are available from AGC and CIMC.)

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Job sheets

      1. Job Sheet #1 — Construct a Garden Wall with Screen or Grill Block, Using Mortarless Joints

      2. Job Sheet #2 — Construct a Partition Wall with Fluted or Sculptured Block, Using Mortarless Joints

      3. Job Sheet #3 — Construct a Section of Wall, Using Slump Block

   E. Test

   F. Answers to test

SUGGESTED ACTIVITIES

III. Unit references

A. *Information Series Tek 42: Masonry Concrete Units.* Herndon, Virginia: National Concrete Masonry Association, 1972.

B. *Information Series Tek 83: Masonry Concrete Units.* Herndon, Virginia: National Concrete Masonry Association, 1977.

C. *Pamphlet No. 3, Vol. 25.* Arlington, Virginia: National Concrete Masonry Association, 1969.

D. Taylor, Merlin, and Harland Randolph. *The Bricklayer,* Vol. I, *Brick and Block Construction.* Washington, D.C.: International Masonry Apprenticeship Trust, 1977.

E. Turcotte, Raymond J. *Bricklaying Curriculum.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1977.

CUSTOMIZED OR ARCHITECTURAL MASONRY UNITS
UNIT I

INFORMATION SHEET

I. Terms and definitions

A. Absorption — Process of taking in moisture

B. ASTM — American Society for Testing and Materials

C. Cap block — Solid block used to top off a wall

D. Consistency — Degree of firmness, density, viscosity, or resistance to movement

E. Deterioration — Action or process of becoming inferior in quality or value

F. Dimensions — Size or measurements

G. Dry bond method — Method of laying masonry without mortar

H. Durability — Ability to withstand the elements without significant deterioration

I. Flutes — Vertical parallel grooves on architectural block

J. Load-bearing walls — Walls that are capable of supporting loads such as floors, ceilings, and roofs as well as their own weight

K. Mortarless joint method — Type of construction whereby blocks are laid, secured in position, and bonded, such as by applying bonding adhesive over entire interior and exterior surface, by placing vertical steel rods and grout in some of the cores, or by parging the back side of wall

L. Non-load-bearing walls — Walls that support only their own weight

M. Plumb — Perfect vertical line

N. Score — Line or groove cut or molded into face of masonry unit

O. Slumper - Mechanical unit with vibrator and heat plate; used to compress and slump blocks after they are removed from mold

(NOTE: Slump blocks are molded about $4\frac{1}{4}$" thick, then slumped until they are $3\frac{5}{8}$" thick; to obtain proper texture through this process, the consistency of the mix is critical.)

P. Strength — Measure of unit's capacity to carry loads and withstand structural stress without crushing

INFORMATION SHEET

Q. Texture — Visual or tactile surface characteristics of units

R. Thermal — Of, relating to, or caused by heat

II. Slump block, split-face block, and adobe block

A. Slump block — Block made with a wet mixture of sand and cement with little or no aggregate, removed from mold, then slumped, creating a rather rough-shaped unit

B. Split-face block — Solid concrete unit split lengthwise to resemble rough quarried stone; by changing mix and pigment, blocks may be produced with different textures and colors

C. Adobe — Type of slump block produced in an adobe color, used to represent the original earth and straw adobe

III. Types of customized or architectural masonry units (Figures 1-25)

(NOTE: These are only a few of the different types and sizes of customized or architectural masonry units.)

A. Screen or grill

FIGURE 1

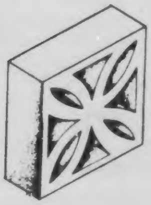


FIGURE 2

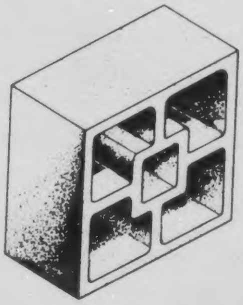
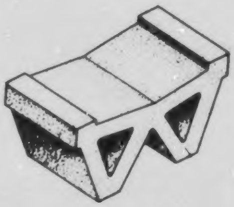


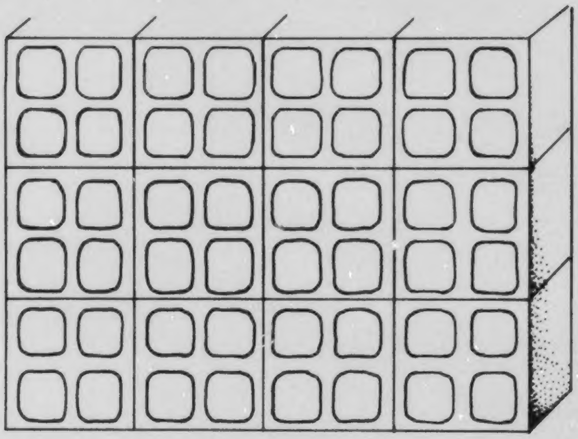
FIGURE 3



INFORMATION SHEET

EXAMPLE:

FIGURE 4 Wall with Screen or Grill Block



B. Fluted

FIGURE 5

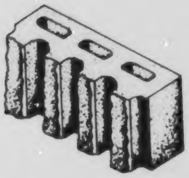


FIGURE 6

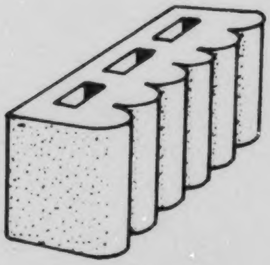
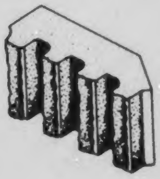


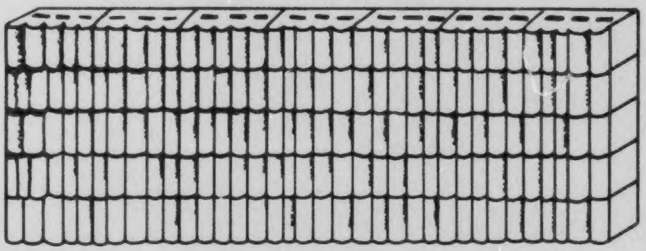
FIGURE 7



EXAMPLE:

FIGURE 8

Wall with Fluted Block



INFORMATION SHEET

C. Sculptured or pattern

FIGURE 9

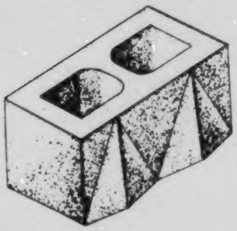


FIGURE 10

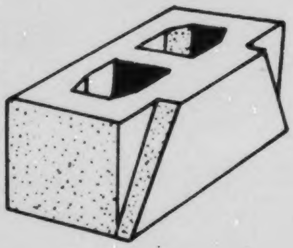
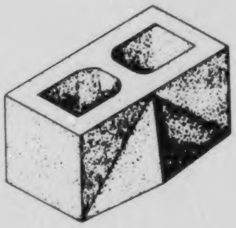


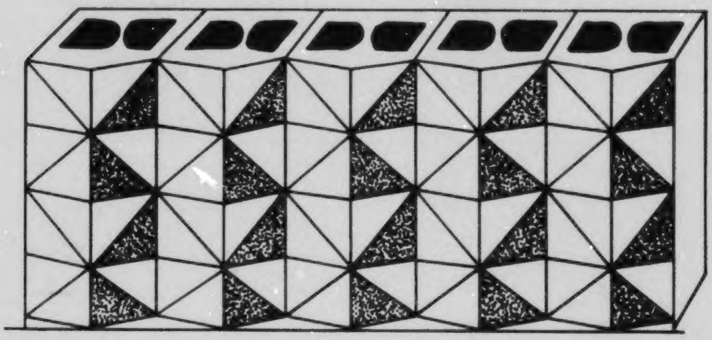
FIGURE 11



EXAMPLE:

FIGURE 12

Garden Wall with Sculptured or Pattern Block



D. Scored or split rib

FIGURE 13

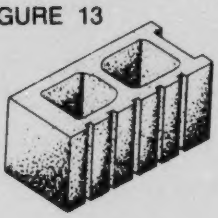
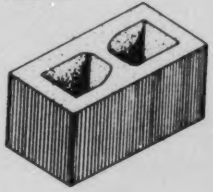


FIGURE 14



INFORMATION SHEET

FIGURE 15

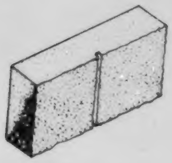
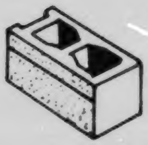


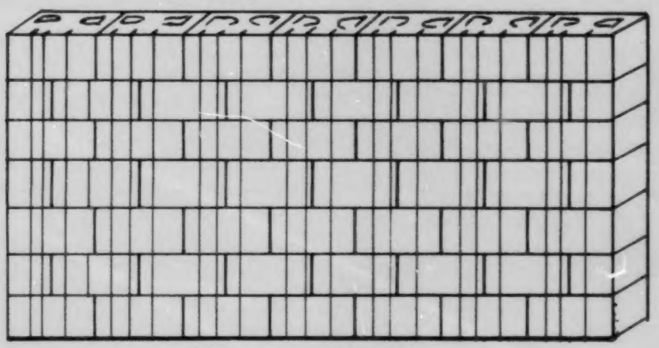
FIGURE 16



EXAMPLE:

FIGURE 17

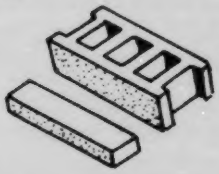
Wall with Scored Block



E. Other types

1. Split face

FIGURE 18

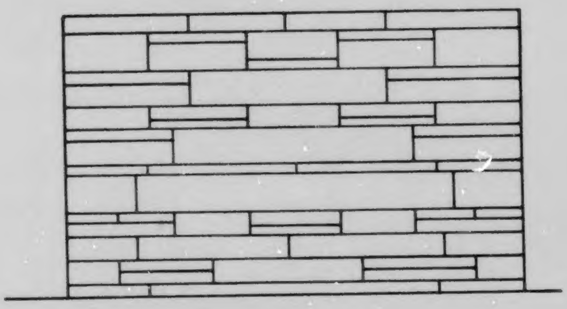


INFORMATION SHEET

EXAMPLE:

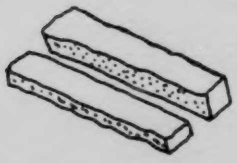
FIGURE 19

Wall with Split-Face Block



2. Slump

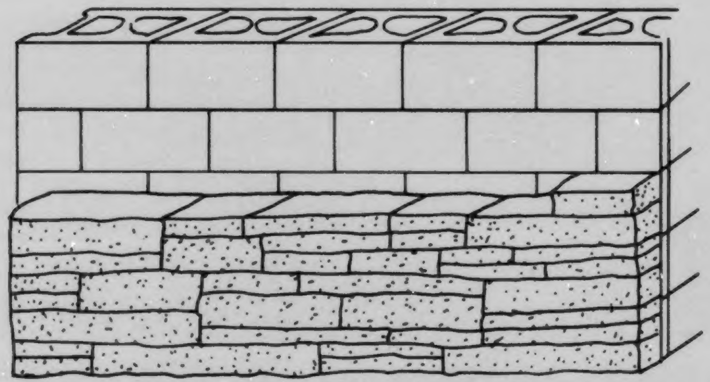
FIGURE 20



EXAMPLE:

FIGURE 21

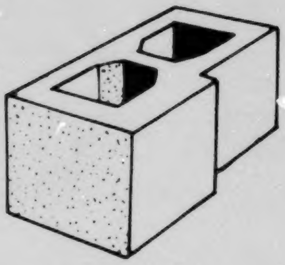
Veneer Wall with Slump Block



INFORMATION SHEET

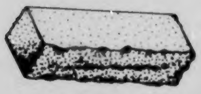
3. Offset face

FIGURE 22



4. Adobe

FIGURE 23



5. Sound

FIGURE 24

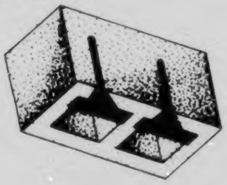
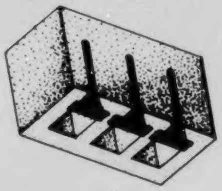


FIGURE 25



IV. Ways types of block are distinguished

A. ASTM designation

B. Dimensions

C. Name associated with function or shape

V. Characteristics of masonry units

A. Strong

B. Durable

C. Water absorbent

D. Insulating

E. Attractive

INFORMATION SHEET

- F. Thermal conductive
- G. Fire enduring

VI. Specifications and ASTM designations of some masonry units

- A. C 90 — Hollow load-bearing
- B. C 129 — Hollow non-load-bearing
- C. C 145 — Solid load-bearing
- D. C 55 — Concrete brick

VII. Factors to consider before using customized or architectural masonry units

- A. Characteristics of masonry units
- B. Locality
- C. Availability
- D. Cost

VIII. Main factors for determining where a unit should be used

- A. Weathering
- B. Moisture content
- C. Weight of unit
- D. Load to support

IX. Procedures for setting slump block, split-face block, and adobe block

- A. Read specifications
- B. Clean area where units are to be set
- C. Lay out wall
- D. Install wall ties
- E. Spread mortar
- F. Set units

INFORMATION SHEET

G. Install reinforcement as specified

H. Check dimensions, plumb, level, and alignment

I. Strike joints

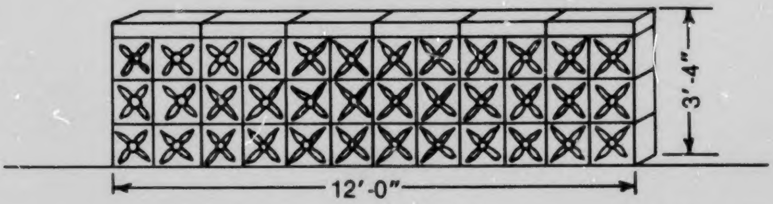
J. Clean wall

K. Restrike joints

L. Clean wall thoroughly after mortar is hard

CUSTOMIZED OR ARCHITECTURAL MASONRY UNITS
UNIT I

JOB SHEET #1 — CONSTRUCT A GARDEN WALL WITH SCREEN OR GRILL BLOCK, USING MORTARLESS JOINTS



I. Equipment and materials

- A. Brick trowel
- B. Brick hammer
- C. Mason's level
- D. Mason's line and line blocks
- E. Thirty-six 8" × 12" × 12" screen or grill blocks
- F. Six 4" × 8" × 24" cap blocks
- G. Specifications and/or job plans

II. Procedure

- A. Lay first block at left end of established wall line

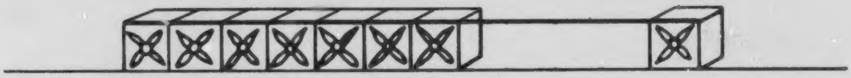
  (NOTE: Keep block lined up with established wall line and with end line.)
- B. Lay second block at opposite end even with established wall line
- C. Attach line blocks and stretch line between the two end blocks

JOB SHEET #1

D. Continue laying remainder of first course, laying to the line (Figure 26)

(NOTE: When laying blocks with mortarless joints, keep blocks tight against each other.)

FIGURE 26



E. Lay first block of second course at left end

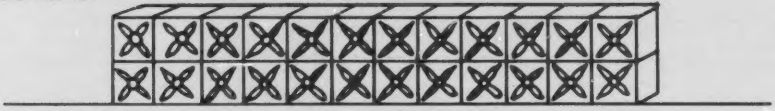
F. Plumb end and face of block

G. Lay second block at opposite end even with block in first course

H. Attach line blocks and stretch line between the two end blocks

I. Continue laying remainder of second course, using same procedures as in first course (Figure 27)

FIGURE 27



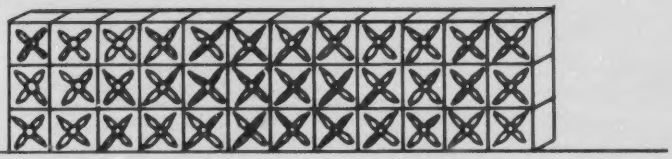
J. Lay first block of third course at left end

K. Plumb end and face of block

L. Lay second block at opposite end even with blocks in other courses

M. Continue laying remainder of third course, using same procedures as in first and second courses (Figure 28)

FIGURE 28



JOB SHEET #1

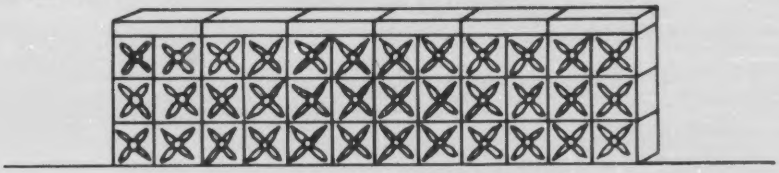
N. Lay first cap block at left end

O. Plumb end and face of block

P. Lay second cap block tight against first cap block and plumb the face

Q. Continue laying remainder of cap blocks, keeping faces plumb (Figure 29)

FIGURE 29

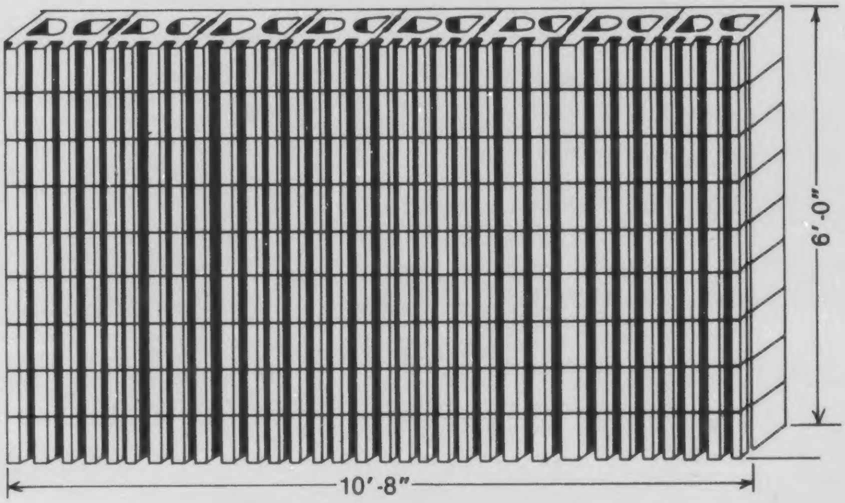


R. Check height, alignment, level, and plumb of wall and cap blocks

S. Clean work area; clean and put away all tools and equipment

CUSTOMIZED OR ARCHITECTURAL MASONRY UNITS
UNIT I

JOB SHEET #2 — CONSTRUCT A PARTITION WALL WITH FLUTED OR SCULPTURED BLOCK, USING MORTARLESS JOINTS



I. Equipment and materials

- A. Brick trowel
- B. Brick hammer
- C. Mason's level
- D. Mason's line and line blocks
- E. Sixty-eight 8" × 8" × 16" fluted or sculptured blocks
- F. Eight 8" × 8" × 8" fluted or sculptured half blocks
- G. Specifications and/or job plans

JOB SHEET #2

II. Procedure

A. Lay first block at left end of established wall line

(NOTE: Keep block lined up with established wall line and end line.)

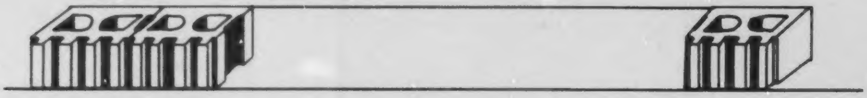
B. Lay second block at opposite end even with established wall line

C. Attach line blocks and stretch line between the two end blocks

D. Continue laying remainder of first course, laying to the line (Figure 30)

(NOTE: When laying blocks with mortarless joints, keep blocks tight against each other.)

FIGURE 30



E. Lay first block of second course at left end

(NOTE: The end blocks of every other course will be half blocks.)

F. Plumb end and face of block

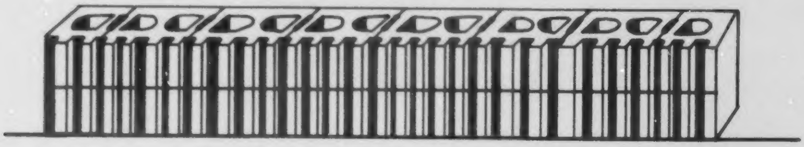
(NOTE: Be sure the flutes on the block are aligned.)

G. Lay second block at opposite end even with block in first course

H. Attach line blocks and stretch line between the two end blocks

I. Continue laying remainder of second course, using the same procedures as in first course (Figure 31)

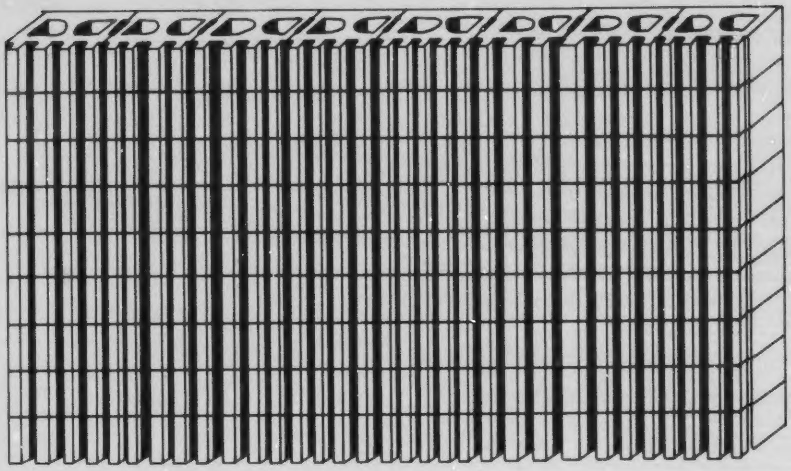
FIGURE 31



JOB SHEET #2

J. Continue laying all the block, using the same procedures and keeping the flutes aligned (Figure 32)

FIGURE 32

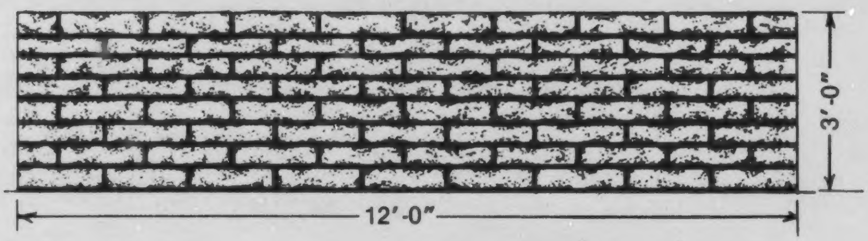


(NOTE: The proper procedure at this point for a mortarless wall would be to insert reinforcing rods into some of the cores of the blocks and then fill the cores with grout.)

K. Clean work area; clean and put away all tools and equipment

CUSTOMIZED OR ARCHITECTURAL MASONRY UNITS
UNIT I

JOB SHEET #3 — CONSTRUCT A SECTION OF WALL, USING SLUMP BLOCK



I. Equipment and materials

- A. Brick trowel
- B. Brick hammer
- C. Stonemason's hammer
- D. Chisel
- E. Bricklayer's level
- F. Rule or tape
- G. Mortarboard and stand
- H. Mortar box, hoe, and shovel
- I. Water bucket and water hose
- J. Bricklayer's brush
- K. Jointer (as specified)
- L. 81 slump blocks
- M. Mortar
- N. Specifications and/or job plans

JOB SHEET #3

II. Procedure

A. Read specifications

B. Clean area where blocks are to be set

C. Lay out wall according to specifications

D. Mix mortar

E. Spread bed of mortar for two blocks

F. Place first block on mortar and press it down firmly until it has a 3/8-inch joint (or a bed joint that is specified); keep face and end of block even with layout lines (Figure 33)

FIGURE 33

G. Check height of block

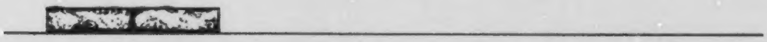
H. Level and plumb block

I. Pick up second block and apply enough mortar on end of block for a full head joint

J. Set second block, following steps F through H (Figure 34)

(NOTE: Be sure to keep ends of block even with layout lines.)

FIGURE 34



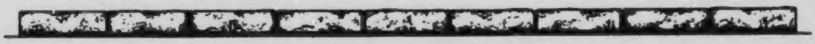
K. Continue laying first course of block to layout line, repeating steps E through I

JOB SHEET #3

L. Remove mortar at base of blocks, and make sure blocks are even with layout lines (Figure 35)

(NOTE: Be very careful not to smear face of block with mortar because the face on slump block is rough and very hard to clean.)

FIGURE 35



M. Check first course for level

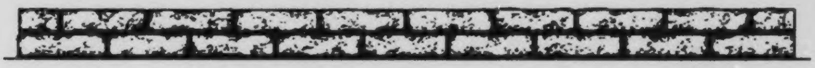
N. Tap high end of block lightly to level if necessary

O. Spread mortar for second course

P. Lay blocks for second course, maintaining correct bed and head joints, level, and plumb (Figure 36)

(NOTE: Before starting second course, it will be necessary to cut one bock in half. This will also need to be done for every other course.)

FIGURE 36

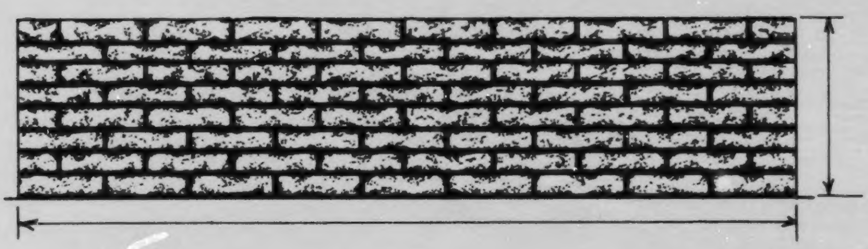


Q. Continue laying courses to desired wall height

JOB SHEET #3

R. As wall progresses, continue to maintain correct head and bed joints, level, plumb, and alignment (Figure 37)

FIGURE 37



S. Clean face of wall

T. Clean work area; clean and put away all tools and equipment

CUSTOMIZED OR ARCHITECTURAL MASONRY UNITS
UNIT I

TEST

NAME ____ SCORE ________________

1. **Match terms associated with customized or architectural masonry units to their correct definitions. Write the correct numbers in the blanks. Terms and definitions are continued on the next page.**

______a. Walls that support only their own weight

______b. Perfect vertical line

______c. Degree of firmness, density, viscosity, or resistance to movement

______d. Method of laying masonry without mortar

______e. Solid block used to top off a wall

______f. Type of construction whereby blocks are laid, secured in position, and bonded, such as by applying bonding adhesive over entire interior and exterior surface, by placing vertical steel rods and grout in some of the cores, or by parging the back side of wall

______g. Ability to withstand the elements without significant deterioration

______h. Vertical parallel grooves on architectural block

______i. Measure of unit's capacity to carry loads and withstand structural stress without crushing

______j. American Society for Testing and Materials

______k. Size or measurements

______l. Walls that are capable of supporting loads such as floors, ceilings, and roofs as well as their own weight

______m. Line or groove cut or molded into face of masonry unit

1. **Dry bond method**
2. **ASTM**
3. **Mortarless joint method**
4. **Durability**
5. **Plumb**
6. **Flutes**
7. **Non-load-bearing walls**
8. **Load-bearing walls**
9. **Consistency**
10. **Cap block**
11. **Strength**
12. **Score**
13. **Dimensions**

TEST

_____n. Mechanical unit with vibrator and heat plate; used to compress and slump blocks after they are removed from mold

_____o. Visual or tactile surface characteristics of units

_____p. Process of taking in moisture

_____q. Action or process of becoming inferior in quality or value

_____r. Of, relating to, or caused by heat

14. Texture
15. Absorption
16. Thermal
17. Deterioration
18. Slumper

2. Describe slump block, split-face block, and adobe block.

a. Slump block — ______________________________

____

____

b. Split-face block — ______________________________

____

____

c. Adobe block — ______________________________

____

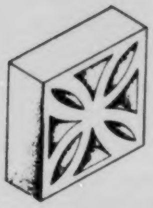
____

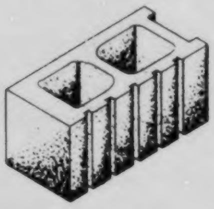
TEST

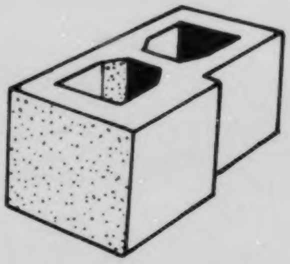
3. Identify the following types of customized or architectural masonry units. Write the correct names in the blanks provided. Answers may be used more than once.

Sculptured or pattern
Screen or grill
Scored or split rib
Offset face
Adobe

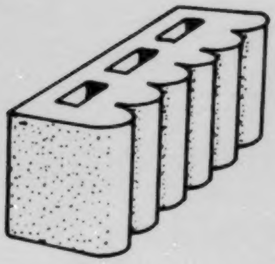
Fluted
Split face
Slump
Sound

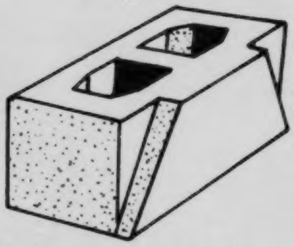


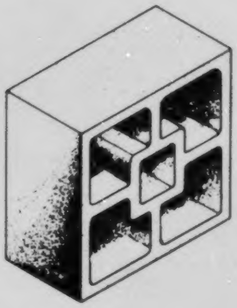




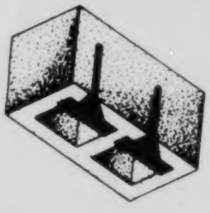
a. ____________________ b. ____________________ c. ____________________

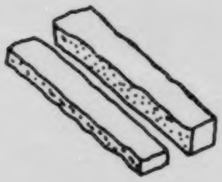


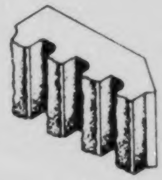




d. ____________________ e. ____________________ f. ____________________

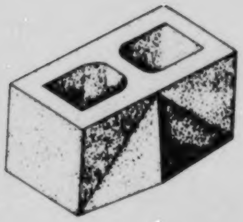




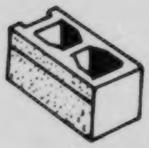


g. ____________________ h. ____________________ i. ____________________

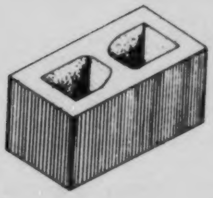
TEST



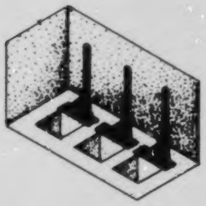
j. ______________________



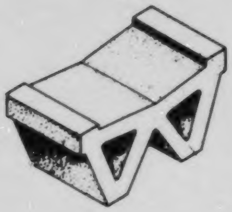
k. ______________________



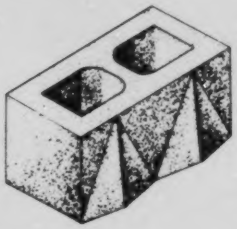
l. ______________________



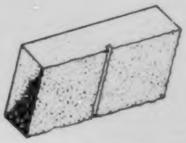
m. ______________________



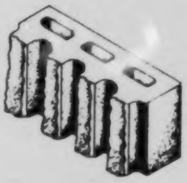
n. ______________________



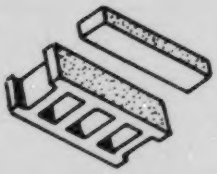
o. ______________________



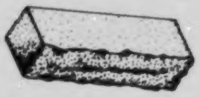
p. ______________________



q. ______________________



r. ______________________



s. ______________________

TEST

4. State ways types of block are distinguished from each other.

a. ______________________________

b. ______________________________

c. ______________________________

5. State three characteristics of masonry units.

a. ______________________________

b. ______________________________

c. ______________________________

6. Match specifications of some masonry units to their correct ASTM designations. Write the correct numbers in the blanks.

______a. Solid load-bearing

______b. Hollow non-load-bearing

______c. Concrete brick

______d. Hollow load-bearing

1. C 129
2. C 90
3. C 145
4. C 55

7. State three factors to consider before using customized or architectural masonry units.

a. ______________________________

b. ______________________________

c. ______________________________

8. State three main factors for determining where a unit should be used.

a. ______________________________

b. ______________________________

c. ______________________________

9. Arrange in order the procedures for setting slump block, split-face block, and adobe block. Write a "1" before the first step, a "2" before the second step, and so on. Steps are continued on the following page.

______a. Install wall ties

______b. Restrike joints

______c. Install reinforcement as specified

______d. Clean area where units are to be set

TEST

_____e. Clean wall

_____f. Spread mortar

_____g. Lay out wall

_____h. Check dimensions, plumb, level, and alignment

_____i. Clean wall thoroughly after mortar is hard

_____j. Set units

_____k. Strike joints

_____l. Read specifications

NOTE: Test question 10 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

10. Demonstrate the ability to

    a. Construct a garden wall with screen or grill block, using mortarless joints.

    b. Construct a partition wall with fluted or sculptured block, using mortarless joints.

    c. Construct a section of wall, using slump block.

CUSTOMIZED OR ARCHITECTURAL MASONRY UNITS
UNIT I

ANSWERS TO TEST

1.

a.	7	f.	3	k.	13	p.	15
b.	5	g.	4	l.	8	q.	17
c.	9	h.	6	m.	12	r.	16
d.	1	i.	11	n.	18		
e.	10	j.	2	o.	14		

2. Description should include the following

   a. Slump block — Block made with a wet mixture of sand and cement with little or no aggregate, removed from mold, then slumped, creating a rather rough-shaped unit.

   b. Split-face block — Solid concrete unit split lengthwise to resemble rough quarried stone; by changing mix and pigment, blocks may be produced with different textures and colors

   c. Adobe — Type of slump block produced in an adobe color, used to represent the original earth and straw adobe

3.

a.	Screen or grill	k.	Scored or split rib
b.	Scored or split rib	l.	Scored or split rib
c.	Offset face	m.	Sound
d.	Fluted	n.	Screen or grill
e.	Sculptured or pattern	o.	Sculptured or pattern
f.	Screen or grill	p.	Scored or split rib
g.	Sound	q.	Fluted
h.	Slump	r.	Split face
i.	Fluted	s.	Adobe
j.	Sculptured or pattern		

ANSWERS TO TEST

4. a. ASTM designation
   b. Dimensions
   c. Name associated with function or shape

5. Answer should include any three of the following
   a. Strong
   b. Durable
   c. Water absorbent
   d. Insulating
   e. Attractive
   f. Thermal conductive
   g. Fire enduring

6. a. 3
   b. 1
   c. 4
   d. 2

7. Answer should include any three of the following
   a. Characteristics of masonry units
   b. Locality
   c. Availability
   d. Cost

8. Answer should include any three of the following
   a. Weathering
   b. Moisture content

ANSWERS TO TEST

c. Weight of unit

d. Load to support

9.	a.	4	g.	3
	b.	11	h.	8
	c.	7	i.	12
	d.	2	j.	6
	e.	10	k.	9
	f.	5	l.	1

10. Performance skills evaluated to the satisfaction of the instructor

GLASS BLOCK
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to identify different styles of glass block, state uses of glass block, and install glass block. The student will show this knowledge by completing the job sheet and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with glass block.
2. Name major classifications of glass block.
3. Identify styles of glass block.
4. State advantages of using glass block.
5. Select from a list actual sizes of glass blocks.
6. State factors to consider when selecting type of glass block to use.
7. Select from a list accessories and/or materials used in glass block installation.
8. Demonstrate the ability to install 8-inch glass block in an opening.

GLASS BLOCK
UNIT II

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Gather samples of glass block and accessories so that students may familiarize themselves with these materials.

   B. Gather materials needed to demonstrate procedures in job sheet.

   C. Provide students with objective sheet.

   D. Discuss unit and specific objectives.

   E. Provide students with information and job sheets.

   F. Discuss information sheet.

   G. Provide students with techniques and hints unique to laying glass block.

   H. Provide equipment and materials so that students may accomplish procedures outlined in job sheet.

   I. Demonstrate and discuss procedures outlined in job sheet.

   J. Have students practice setting glass block using the shoving method before trying to accomplish the job sheet.

   K. Bring in someone who is familiar with laying glass block if you are unfamiliar with this process.

   L. Teach this unit only to advanced students.

   M. Give test.

   N. Complete appropriate section of competency profiles.

   (NOTE: Competency profiles are available from AGC and CIMC.)

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Job Sheet #1 — Install 8-inch Glass Block in an Opening

SUGGESTED ACTIVITIES

E. Test

F. Answers to test

III. Unit reference — *Glass Block for the 80s — Design with Confidence*. GB-164, rev. Pittsburgh, Pennsylvania: Pittsburgh Corning Corporation, 1982.

GLASS BLOCK
UNIT II

INFORMATION SHEET

I. Terms and definitions

A. Anchor — Device that holds an object firmly in place

B. Asphalt emulsion — Bituminous substance applied to the sill; acts as a sealant

C. ASTM — American Society for Testing and Materials

D. Burlap — Coarse, heavy, plain-woven fabric of jute or hemp used for cleaning glass block

E. Chase — Continuous recess or channel; usually a vertical groove

F. Compress — To squeeze together

G. Expansion — Act or process of enlarging or stretching

H. Laboratory mortar — Type of mortar consisting of sand, lime, and water

I. Neoprene — Oil-resistant synthetic rubber

J. Oakum — Loosely twisted hemp or jute fiber impregnated with tar or a tar derivative; used to caulk joints

K. Polyethylene foam — Thermoplastic, high-molecular-weight, organic compound used in formulating protective coatings and coverings

L. Reinforcing mesh — Material used to strengthen masonry walls

M. Shoving method — Method of working units into place with the hands, thereby compressing head joints

N. Solar reflective — That which reduces the penetration of the sun's rays

O. Thermal resistance — Reduction of heat transmission

P. Thermoplastic — Plastic that becomes soft when heated and hard when cooled

II. Major classifications of glass block

A. Functional

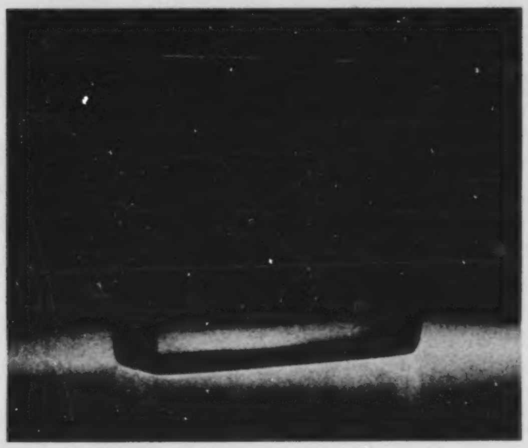
B. Decorative

INFORMATION SHEET

III. Styles of glass block (Figures 1-7)

A. VISTABRIK® (solid glass block)

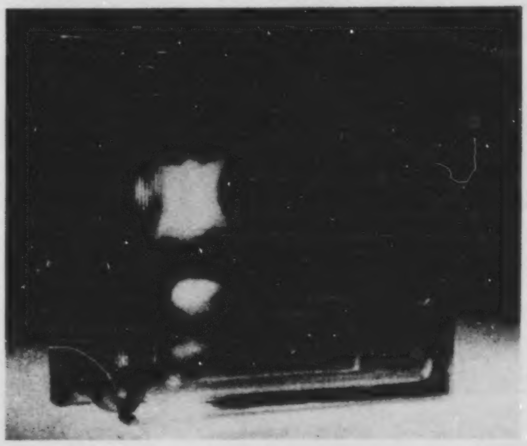
FIGURE 1



Courtesy of Pittsburgh Corning Corporation.

B. Solar reflective

FIGURE 2

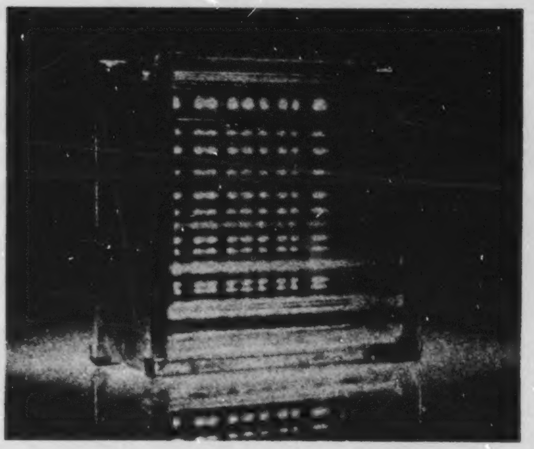


Courtesy of Pittsburgh Corning Corporation.

INFORMATION SHEET

C. ARGUS®

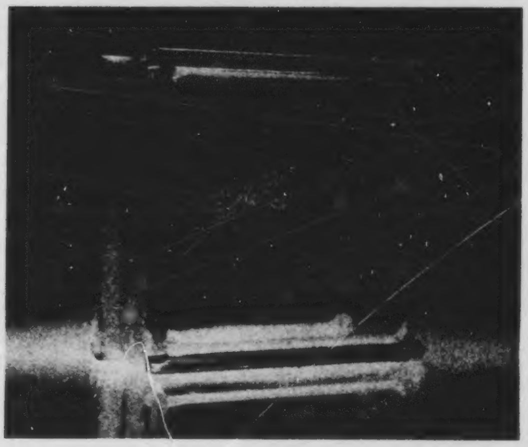
FIGURE 3



Courtesy of Pittsburgh Corning Corporation.

D. VUE®

FIGURE 4

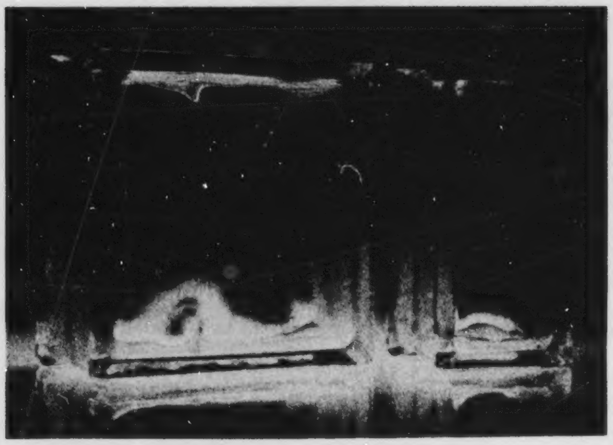


Courtesy of Pittsburgh Corning Corporation.

INFORMATION SHEET

E. DECORA®

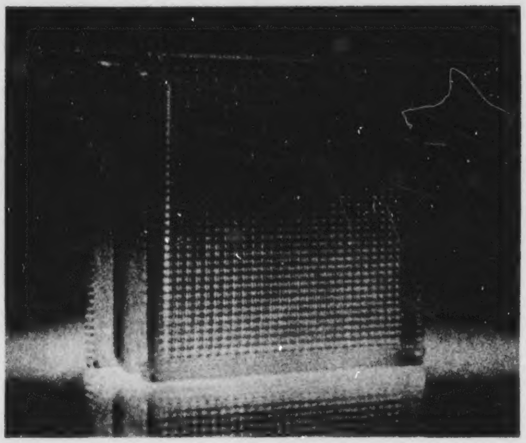
FIGURE 5



Courtesy of Pittsburgh Corning Corporation.

F. ESSEX®

FIGURE 6



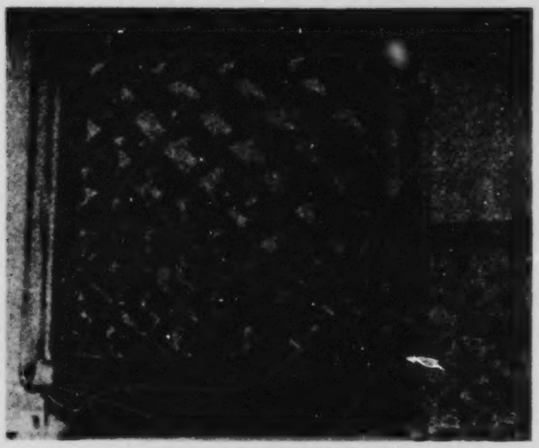
Courtesy of Pittsburgh Corning Corporation.

(NOTE: DECORA® and ESSEX® glass blocks are available with a fibrous glass insert that controls light transmission, glare, brightness, and solar heat gain; it also increases thermal resistance.)

INFORMATION SHEET

G. DELPHI®

FIGURE 7



Courtesy of Pittsburgh Corning Corporation.

IV. Advantages of using glass block

- A. Are permanent
- B. Are maintenance free
- C. Are decorative
- D. Improve security
- E. Transmit light
- F. Improve insulation
- G. Reduce sound transmittal
- H. Resist fire and impact
- I. Reduce glare and heat penetration
- J. Resist surface condensation

INFORMATION SHEET

V. Actual sizes of glass blocks

- A. 3 3/4" x 7 3/4" x 3 7/8"
- B. 5 3/4" x 7 3/4" x 3 7/8"
- C. 5 3/4" x 5 3/4" x 3 7/8"
- D. 7 5/8" x 7 5/8" x 3"
- E. 7 3/4" x 7 3/4" x 3 7/8"
- F. 11 3/4" x 11 3/4" x 3 7/8"

(NOTE: There is also a series of 3 1/8-inch-thick glass units available in the decora and delphi styles.)

VI. Factors to consider when selecting type of glass block to use

- A. Purpose (functional or decorative)
- B. Appearance
- C. Location and orientation
- D. Type of occupancy
- E. Size of room and distribution
- F. Position of occupants
- G. Interior treatment

VII. Types of accessories and/or materials used in glass block installation

- A. Fiberglass expansion
- B. Galvanized wire mesh reinforcement
- C. Galvanized panel anchors
- D. Aluminum chase
- E. Asphalt emulsion
- F. Oakum or polyethylene foam, neoprene or equal filler
- G. Portland cement (ASTM C-150, Type I)

INFORMATION SHEET

H. Lime (ASTM C-207, very fine)

I. Sand (ASTM C-144, very fine)

J. Waterproofing admixture (Type NV-3389)

K. Caulking (nonstaining, waterproof)

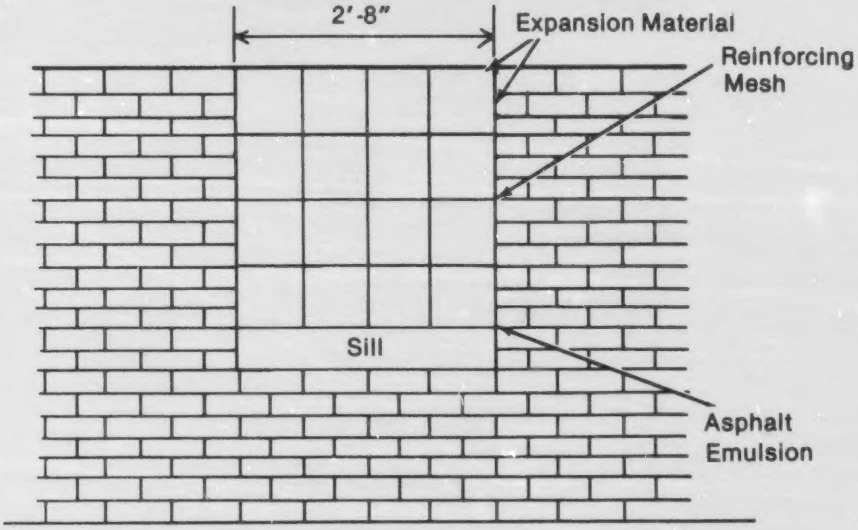
L. Flashing (nonstaining)

M. Aluminum ventilators (hopper and jalousie)

(NOTE: Mortar shall meet ASTM designation C-270; mixing ratio should be 1:14, and waterproofing admixture should be used only when necessary.)

GLASS BLOCK
UNIT II

JOB SHEET #1 — INSTALL 8-INCH GLASS BLOCK IN AN OPENING


2′-8″
Expansion Material
Reinforcing Mesh
Sill
Asphalt Emulsion

I. Equipment and materials

- A. Brick trowel
- B. Modular rule
- C. Brickmason's level
- D. Concave jointer
- E. Rake
- F. Bolt cutters
- G. Stiff-fiber brush and piece of burlap
- H. Mixer or mortar box and hoe
- I. Mortarboard and stand
- J. Square-point shovel
- K. Mortar ingredients or laboratory mortar

JOB SHEET #1

L. 16 glass blocks

M. Expansion material, 4′-0″

N. Reinforcing mesh, 2′-8″

O. Asphalt emulsion

P. Oakum or similar material

Q. Caulking gun and caulking

R. Container of soapsuds and small brush

II. Procedure

A. Apply a heavy coat of asphalt emulsion to sill area and allow to dry

B. Apply asphalt emulsion to jambs and head

C. Press expansion material to emulsion on jambs and head until it adheres

(NOTE: Be sure that the expansion material extends to the sill.)

D. Apply full bed of mortar to sill; do not furrow bed joint; use trowel to smooth out bed joint

E. Use shoving method to set first course of block, leaving 1/4-inch mortar joint if none is specified

(CAUTION: Do not strike glass units with metal tools.)

F. Level, plumb, align, and check course height of first course

(NOTE: The number of blocks laid in successive lifts shall be limited. To prevent squeezing the mortar out or moving units, do not try to hurry the process.)

G. Repeat steps D through F for second and third courses

H. Install reinforcing mesh where specified by applying one-half of mortar to bed joint, pressing reinforcing into place, and then applying second half of mortar to bed joint and smoothing with trowel

(NOTE: Reinforcing must extend from one end of panel to opposite end. If necessary, lap reinforcing at least 6 inches, but do not bridge expansion joint.)

JOB SHEET #1

I. Continue setting all of the blocks, using same procedures as above

(NOTE: The last course is very difficult to set; observe extreme caution. The last block should not be the one at either end because it is impossible to insert the block in this opening.)

J. Strike joints as specified while mortar is still plastic and exposed edges of block have sharp, clean lines

K. Rake out all spaces requiring caulking to a depth equal to width of spaces

L. Clean excess mortar from face of block

M. After final set, pack oakum or other filler between block panel and jamb, and between head and block panel, leaving enough space for caulking

N. Caulk as specified

O. Clean surface of blocks

(NOTE: Do not clean block until mortar has reached final set.)

P. Clean work area

Q. Clean and put away all tools and equipment

GLASS BLOCK
UNIT II

TEST

NAME ______________________________ SCORE ______________

1. Match to their correct definitions terms associated with glass block. Write the correct numbers in the blanks.

______a. Material used to strengthen masonry walls

______b. American Society for Testing and Materials

______c. Type of mortar consisting of sand, lime, and water

______d. Act or process of enlarging or stretching

______e. Loosely twisted hemp or jute fiber impregnated with tar or a tar derivative; used to caulk joints

______f. Device that holds an object firmly in place

______g. Method of working units into place with the hands, thereby compressing head joints

______h. Continuous recess or channel; usually a vertical groove

______i. Coarse, heavy, plain-woven fabric of jute or hemp used for cleaning glass block

______j. To squeeze together

______k. Bituminous substance applied to the sill; acts as a sealant

______l. Plastic that becomes soft when heated and hard when cooled

______m. Reduction of heat transmission

______n. That which reduces penetration of the sun's rays

______o. Oil-resistant synthetic rubber

______p. Thermoplastic, high-molecular-weight, organic compound used in formulating protective coatings and coverings

1. Laboratory mortar
2. Burlap
3. Anchor
4. Reinforcing mesh
5. Asphalt emulsion
6. Expansion
7. Compress
8. Shoving method
9. ASTM
10. Chase
11. Oakum
12. Solar reflective
13. Polyethylene foam
14. Thermoplastic
15. Neoprene
16. Thermal resistance

TEST

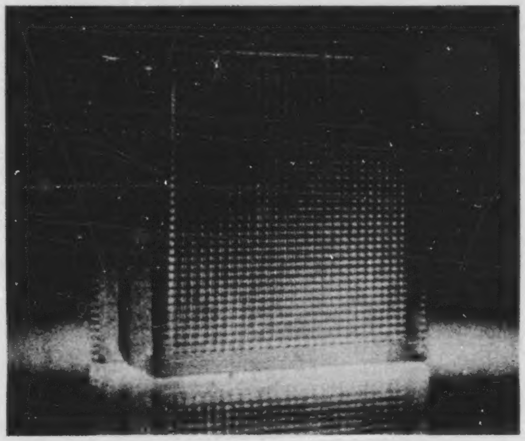
2. Name major classifications of glass block.

   a. ______________________________

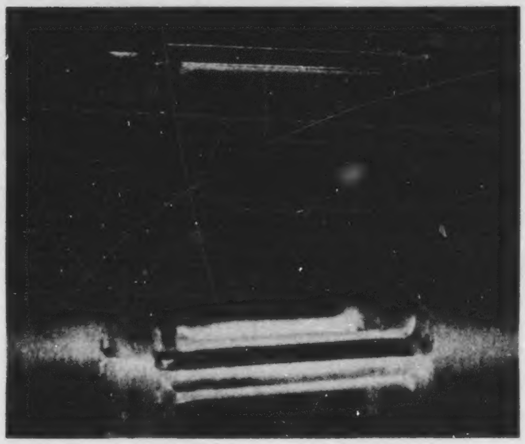
   b. ______________________________

3. Identify the following styles of glass block. Write the correct names in the blanks.

ESSEX®
DELPHI®
DECORA®
Solar reflective
ARGUS®
VUE®
VISTABRIK® (solid glass block)

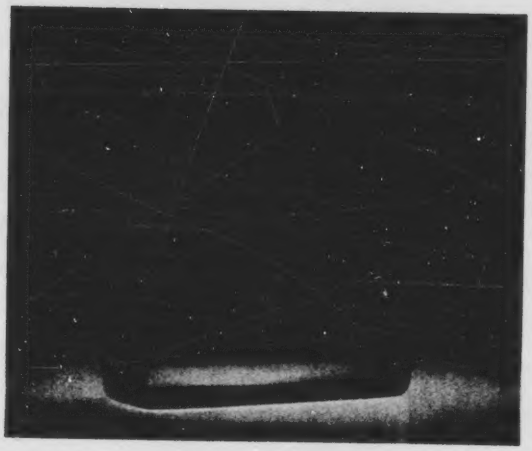


a. ______________________

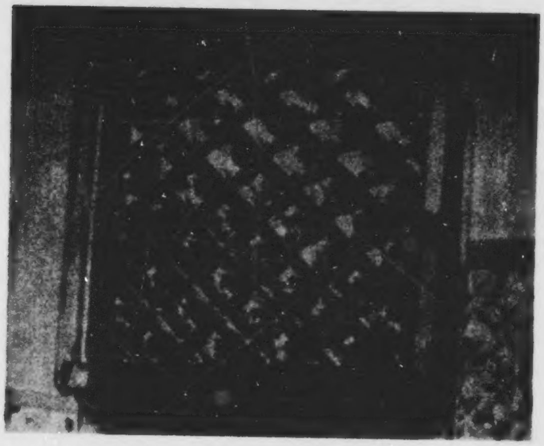


b. ______________________

TEST

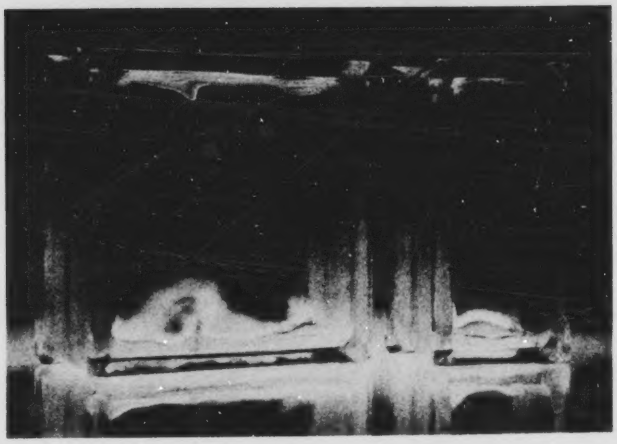


c. ______________________________

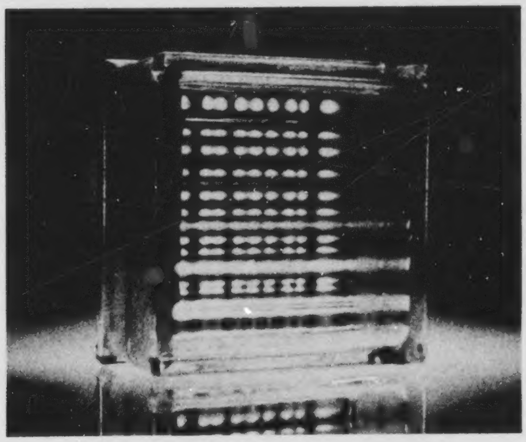


d. ______________________________

TEST

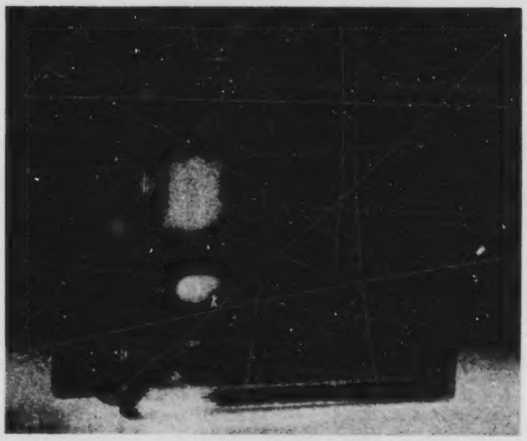


e. ______________________________



f. ______________________________

TEST



g. ______________________________

4. State five advantages of using glass block.

a. ____

b. ____

c. ____

d. ____

e. ____

5. Select from the following list actual sizes of glass blocks. Write an "X" in the blank before each correct answer.

_____a. 8" x 8" x 16"

_____b. 2" x 4" x 8"

_____c. 7 3/4" x 7 3/4" x 3 7/8"

_____d. 5 3/4" x 5 3/4" x 3 7/8"

_____e. 3 3/4" x 3 3/4" x 7 3/4"

_____f. 7 5/8" x 7 5/8" x 3"

_____g. 5 3/4" x 7 3/4" x 3 7/8"

_____h. 11 5/8" x 11 5/8" x 3 5/8"

_____i. 3 3/4" x 7 3/4" x 3 7/8"

_____j. 11 3/4" x 11 3/4" x 3 7/8"

TEST

6. State three factors to consider when selecting type of glass block to use.

a. ____

b. ____

c. ____

7. Select from the following list types of accessories and/or materials used in glass block installation. Write an "X" in the blank before each correct answer.

_____a. Asphalt emulsion

_____b. Caulking (nonstaining, waterproof)

_____c. Aluminum chase

_____d. Portland cement (ASTM C-340, Type V)

_____e. Aluminum ventilators (hopper and jalousie)

_____f. Waterproofing admixture (Type NV-3389)

_____g. Oakum or polyethylene foam, neoprene or equal filler

_____h. Preformed steel rod reinforcement

_____i. Preformed asphalt expansion material

_____j. Lime (ASTM C-207, very fine)

_____k. Galvanized panel anchors

_____l. Coarse sand

_____m. Flashing (nonstaining)

(NOTE: Test question 8 lists the job sheet. It is an important part of this test. If it has not been completed, check with your instructor.)

8. Demonstrate the ability to install 8-inch glass block in an opening.

GLASS BLOCK
UNIT II

ANSWERS TO TEST

1.

a.	4
b.	9
c.	1
d.	6
e.	11
f.	3
g.	8
h.	10
i.	2
j.	7
k.	5
l.	14
m.	16
n.	12
o.	15
p.	13

2. a. Functional
   b. Decorative

3. a. ESSEX®
   b. VUE®
   c. VISTABRIK® (solid glass block)
   d. DELPHI®
   e. DECORA®
   f. ARGUS®
   g. Solar reflective

4. Answer should include any five of the following
   a. Are permanent
   b. Are maintenance free
   c. Are decorative
   d. Improve security
   e. Transmit light
   f. Improve insulation
   g. Reduce sound transmittal
   h. Resist fire and impact
   i. Reduce glare and heat penetration
   j. Resist surface condensation

ANSWERS TO TEST

5. c, d, f, g, i, j

6. Answer should include any three of the following

    a. Purpose (functional or decorative)

    b. Appearance

    c. Location and orientation

    d. Type of occupancy

    e. Size of room and distribution

    f. Position of occupants

    g. Interior treatment

7. a, b, c, e, f, g, j, k, m

8. Performance skills evaluated to the satisfaction of the instructor

SILLS, LINTELS, AND COPINGS
UNIT III

UNIT OBJECTIVE

After completing this unit, the student should be able to identify different types of sills, lintels, and copings. The student should also be able to install various types of sills, lintels, and copings. The student will show this knowledge by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with sills, lintels, and copings to their correct definitions.
2. Identify types of sills.
3. Identify types of lintels.
4. State lintel assignments that the bricklayer should be able to perform.
5. Identify types of copings.
6. Demonstrate the ability to
    a. Construct a block wall with a slip sill and precast lintel.
    b. Lay stone coping on top of block wall.
    c. Construct an 8-inch-thick solid brick wall with a lug sill and two angle-iron lintels.
    d. Lay brick rowlock coping on top of brick wall.

SILLS, LINTELS, AND COPINGS
UNIT III

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Provide students with objective sheet.

   B. Discuss unit and specific objectives.

   C. Provide students with information and job sheets.

   D. Discuss information sheet.

   E. Gather equipment and materials needed for job sheet demonstrations.

   F. Demonstrate and discuss procedures outlined in job sheets.

   G. Provide students with specifications and job plans for job sheets.

   H. Give test.

   I. Complete appropriate section of competency profiles.

   (NOTE: Competency profiles are available from AGC and CIMC.)

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Job sheets

      1. Job Sheet #1 — Construct a Block Wall with a Slip Sill and Precast Lintel

      2. Job Sheet #2 — Lay Stone Coping on Top of Block Wall

      3. Job Sheet #3 — Construct an 8-Inch-Thick Solid Brick Wall with a Lug Sill and Two Angle-Iron Lintels

      4. Job Sheet #4 — Lay Brick Rowlock Coping on Top of Brick Wall

   E. Test

   F. Answers to test

SUGGESTED ACTIVITIES

III. Unit references

A. *Chandler Materials Company Catalog*. Tulsa, Oklahoma: Chandler Materials Company, n.d.

B. Kreh, R.T., Sr. *Masonry Skills*. Albany, New York: Delmar Publishers, Inc., 1982.

C. Taylor, Merlin, and Harland Randolph. *The Bricklayer: Brick and Block Construction*, Vol. I, II, and III. Washington, D.C.: International Masonry Apprenticeship Trust, 1977.

D. Turcotte, Raymond J. *Bricklaying Curriculum*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1977.

SILLS, LINTELS, AND COPINGS
UNIT III

INFORMATION SHEET

I. Terms and definitions

A. Cast-in-place sill — Sill that has been formed, poured in place, then finished

B. Coping — Masonry cap or covering laid on top of wall; usually projects from each side of wall to provide protection from moisture penetration

C. Dimension — Measurement or size

D. Furrow — Slight indentation made in mortar bed joint with point of trowel

E. Jamb — Sides of an opening

F. Laboratory mortar — Mortar made from sand and lime

G. Lintel — Horizontal member or beam support placed over a wall opening to carry the weight of the masonry laid over it

H. Lug sill — Precast sill with a 4-inch pad on each end to receive the masonry; set before laying up jamb

I. Overhang — Projection at top part of wall, protruding beyond lower part of wall

J. Rowlock — Position of brick laid horizontally with end of brick that is facing front of wall having more height than width

K. Set — Condition of mortar when it has hardened to an arbitrary degree

L. Sill — Single or composite masonry unit that covers width and depth of the opening, provides support for frame, maintains proper jamb width, and aids drainage

M. Slip sill — Precast sill slipped between jambs of opening; placed before or after jambs are laid up

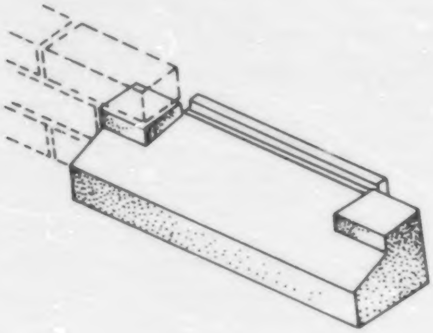
N. Terra-cotta — Brownish orange, glazed or unglazed, fired clay used to make masonry units

INFORMATION SHEET

II. Types of sills (Figures 1-5)

A. Lug

FIGURE 1



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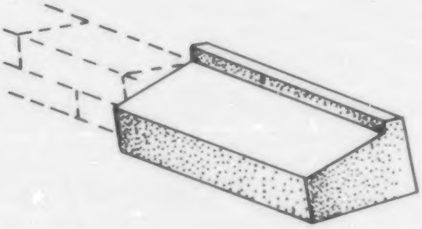
B. Slip

FIGURE 2



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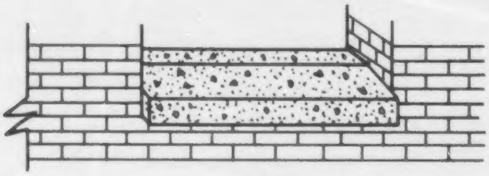
INFORMATION SHEET

C. Cast-in-place (concrete)

(NOTE: A cast-in-place sill may be in any of several designs.)

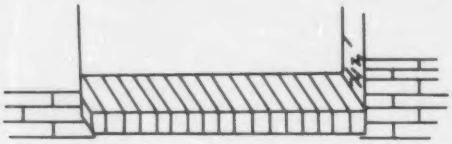
FIGURE 3



D. Special masonry

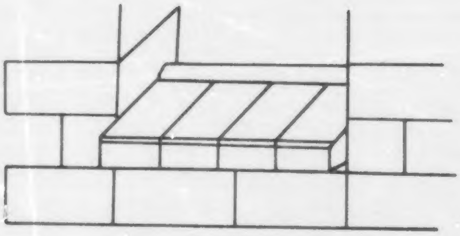
1. Brick rowlock

FIGURE 4



2. Concrete block

FIGURE 5



INFORMATION SHEET

III. Types of lintels (Figures 6-20)

A. Precast

(NOTE: Precast lintels are available in various thicknesses to suit individual block walls, or they may be placed in pairs to suit individual block walls.)

FIGURE 6

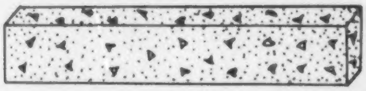
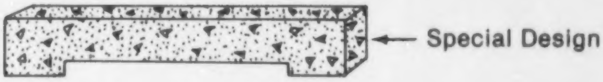


FIGURE 7



B. Angle iron

FIGURE 8

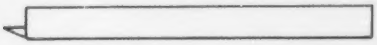
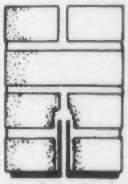
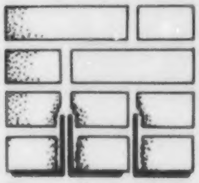


FIGURE 9



Two Angle-Iron Lintels (Side View)

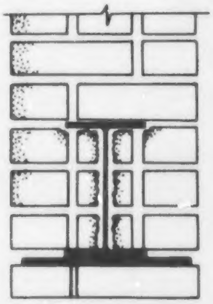
FIGURE 10



Three Angel-Iron Lintels (Side View)

C. Steel I-beam and plate

FIGURE 11

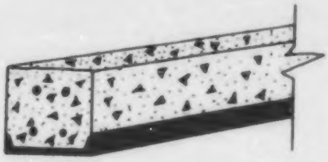


(Side View)

INFORMATION SHEET

D. Poured-in-place over channel iron with reinforced concrete

FIGURE 12



E. Bond beam

FIGURE 13

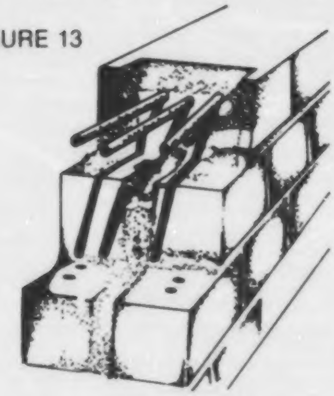
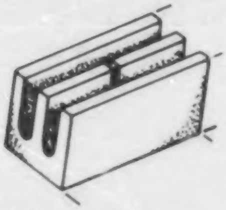
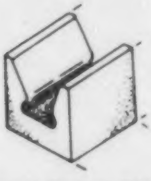


FIGURE 14



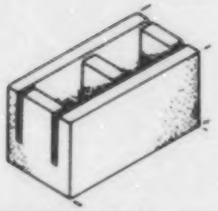
Closed-Bottom
Bond-Beam
Block

FIGURE 15



Bond-Beam Block

FIGURE 16



Open-Bottom
Bond-Beam
Block

INFORMATION SHEET

F. Arch

FIGURE 17

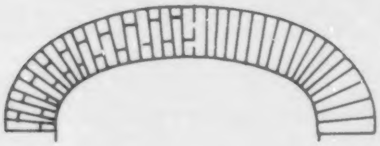


FIGURE 18

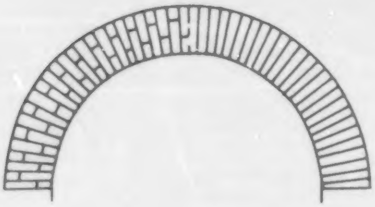


FIGURE 19

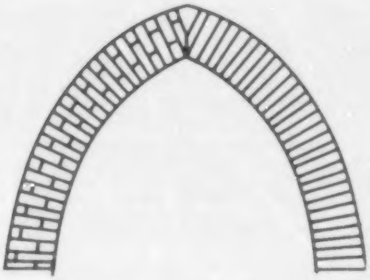
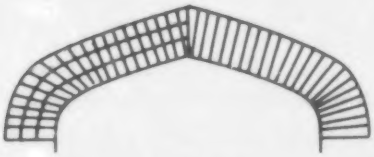


FIGURE 20



Figures 17-20 used with permission of the International Masonry Institute Apprenticeship and Training Program, Washington, D.C.

INFORMATION SHEET

IV. Lintel assignments that the bricklayer should be able to perform

A. Read plans and specifications

B. Lay up wall or piers to receive lintel

C. Construct lintel as specified

D. Set lintel in proper position with specified bearings

E. Align lintel within wall

F. Align adjacent masonry courses

G. Install flashing as specified

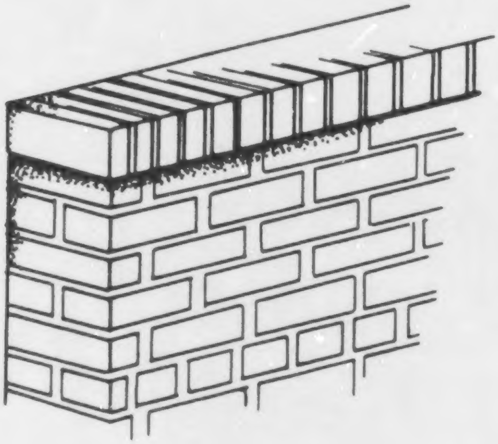
H. Construct control joints at lintel if specified

V. Types of copings (Figures 21-25)

(NOTE: Improperly designed or set coping may result in moisture damage to the structure.)

A. Brick rowlock

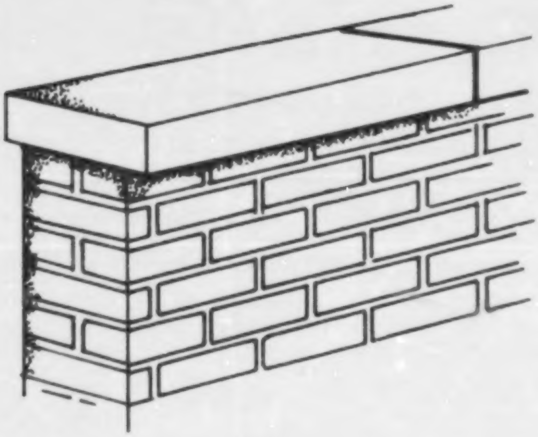
FIGURE 21



INFORMATION SHEET

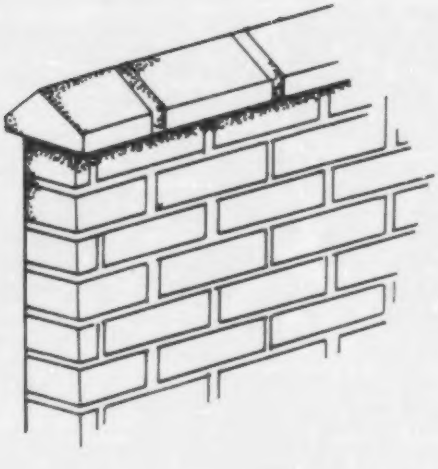
B. Stone

FIGURE 22



C. Molded brick

FIGURE 23

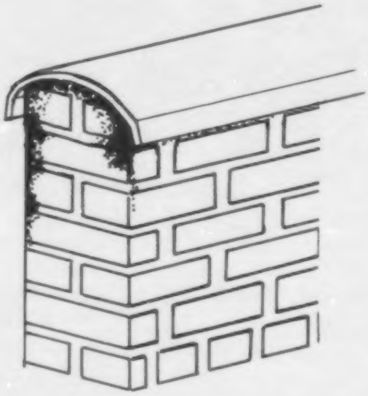


INFORMATION SHEET

D. Terra-cotta

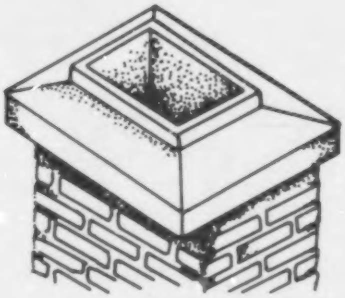
(NOTE: These sections of copings are split before installation and form two separate copings.)

FIGURE 24



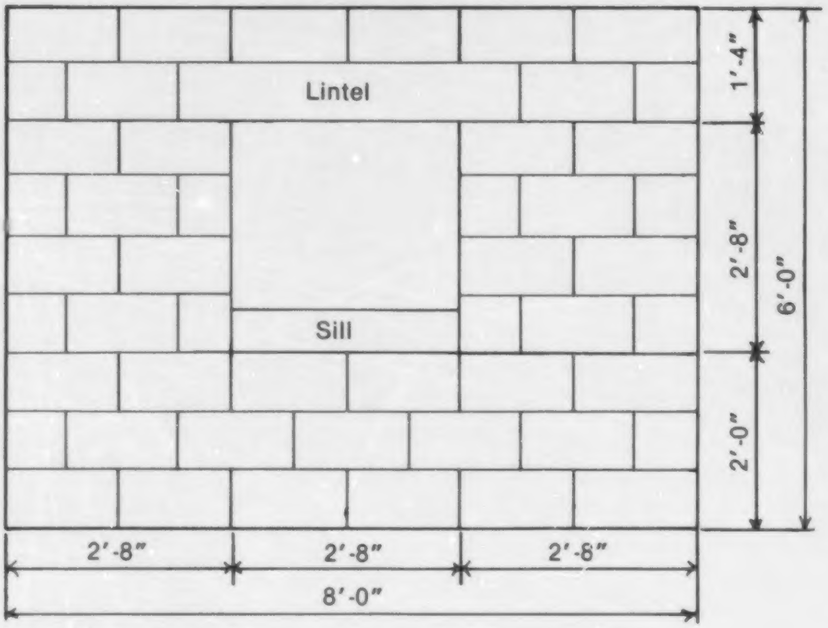
E. Chimney cap (concrete or stone)

FIGURE 25



SILLS, LINTELS, AND COPINGS
UNIT III

JOB SHEET #1 — CONSTRUCT A BLOCK WALL WITH A SLIP SILL AND PRECAST LINTEL



I. Equipment and materials

A. Brick trowel

B. Brick hammer and brick set

C. Modular rule

D. Bricklayer's levels, 4-foot and 2-foot

E. Line blocks and line

F. Jointer

G. Mortar box and hoe

H. Water hose and/or bucket

I. Shovel

J. Mortarboard and stand

K. Mortar ingredients or laboratory mortar

JOB SHEET #1

L. Concrete block, 37 to 24 stretcher blocks and 14 corner blocks

M. 12 concrete block halves, all corners

N. Slip sill, 9 1/2" × 6" × 31 5/8"

O. Precast lintel, 7 5/8" × 7 5/8" × 47 5/8"

P. Specifications and/or job plans

II. Procedure

A. Lay out wall

B. Mix mortar

C. Construct wall to sill opening

D. Check opening

E. Bond sill with full bed and head joints

F. Lower sill into position

G. Plumb back of sill with interior face of wall

H. Level sill across width and depth

I. Check overhang to be sure it is square with exterior face of wall

J. Check specified dimensions of opening to make sure there is enough space for window frame; it may be necessary to adjust sill height

(NOTE: Check dimensions as the work progresses.)

K. Continue laying wall to the lintel height

(NOTE: Be sure the piers on each side of opening are plumb, level, in line, and at proper course height.)

L. Apply mortar to bearing surface

M. Install lintel so that it has specified bearing (at least 4 inches on each side)

(NOTE: You will probably need help to set the lintel.)

N. Level lintel

O. Plumb face with wall face

JOB SHEET #1

P. Check height of lintel

Q. Recheck level and plumb of lintel

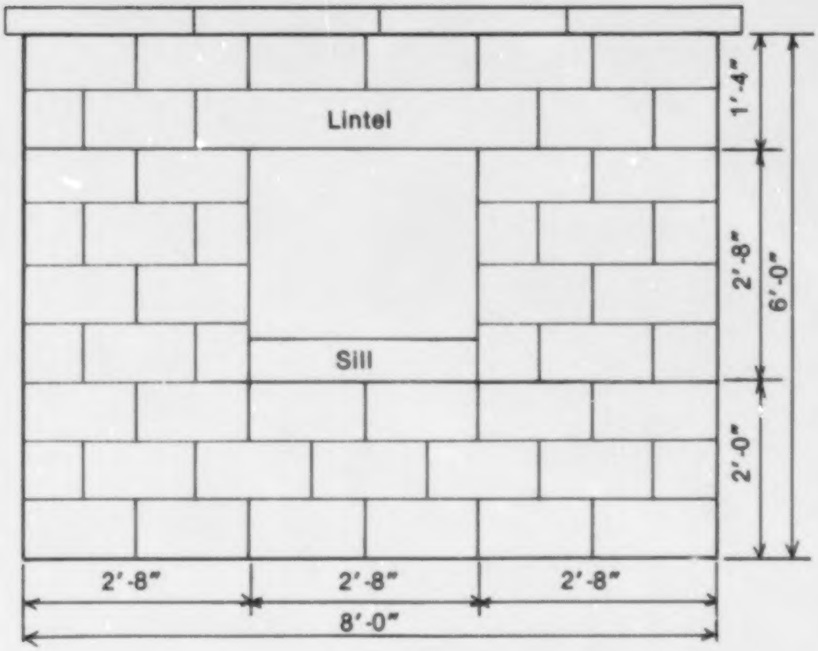
R. Complete the lintel course

S. After mortar has set, continue laying block to the specified height

T. Clean work area; clean and put away all equipment and materials

SILLS, LINTELS, AND COPINGS
UNIT III

JOB SHEET #2 — LAY STONE COPING ON TOP OF BLOCK WALL


Lintel
Sill
1'-4"
2'-8"
6'-0"
2'-0"
2'-8"
2'-8"
2'-8"
8'-0"

I. Equipment and materials

- A. Brick trowel
- B. Brick hammer
- C. Modular rule
- D. Bricklayer's level, 4-foot
- E. Jointer
- F. Mortar box and hoe
- G. Water hose and/or bucket
- H. Shovel
- I. Mortarboard and stand

JOB SHEET #2

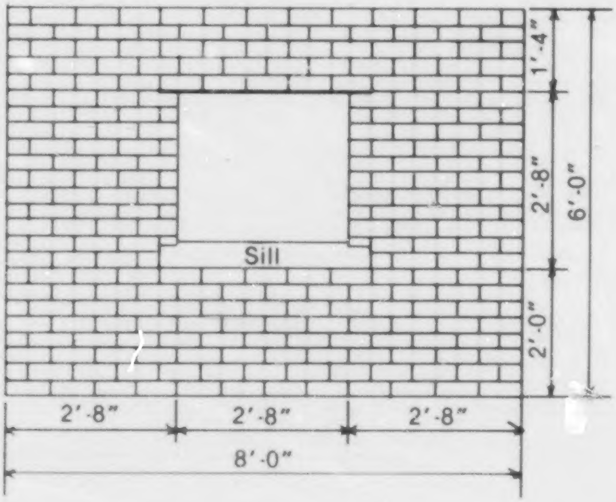
- J. Mortar ingredients or laboratory mortar
- K. Stone coping, 12" × 4" × 24"
- L. Block wall (previously constructed in Job Sheet #1)
- M. Specifications and/or job plans

II. Procedure

- A. Mix mortar
- B. Apply mortar to top of wall
- C. Set first coping on top of wall
- D. Check overhang on sides and end
- E. Level coping lengthwise, then depthwise
- F. Check finished height of coping
- G. Lay coping on opposite end, using procedure in steps B through F
- H. Lay two center copings, using procedure in steps B through F
- I. After copings are all set, check bed joint and fill any holes that may have formed under the projecting edge
- J. Tool the joints as specified
- K. Clean work area; clean and put away all equipment and materials

SILLS, LINTELS, AND COPINGS
UNIT III

JOB SHEET #3 — CONSTRUCT AN 8-INCH-THICK SOLID BRICK WALL WITH A LUG SILL AND TWO ANGLE-IRON LINTELS



I. Equipment and materials

A. Brick trowel

B. Brick hammer and brick set

C. Modular rule

D. Bricklayer's levels, 4-foot and 2-foot

E. Line blocks and line

F. Jointer

G. Mortar box and hoe

H. Water hose and/or bucket

I. Shovel

J. Mortarboard and stand

K. Mortar ingredients or laboratory mortar

JOB SHEET #3

L. 560 standard brick, 4" × 2 2/3" × 8"

M. Lug sill, 9 1/2" × 5 3/4" × 39 5/8"

N. 2 angle-iron lintels, 3 1/2" × 3 1/2" × 40"

O. Specifications and/or job plans

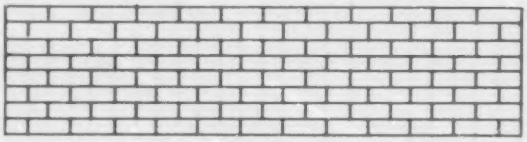
II. Procedure

A. Lay out wall

B. Mix mortar

C. Lay up wall to sill height (Figure 26)

FIGURE 26

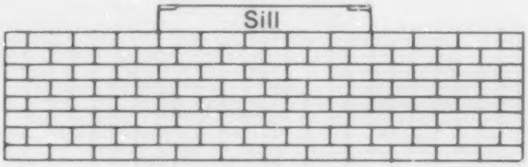


D. Check sill height to be sure it is correct

(NOTE: When applying mortar for bed joint on lug sill, embed only the ends of the sill in mortar. Balance of joint should be pointed later.)

E. Lower sill into position (Figure 27)

FIGURE 27



F. Check specifications for proper location of sill

G. Plumb back of sill with interior face of wall

JOB SHEET #3

H. Level sill across width and depth

(NOTE: Set level across pads on sill when leveling.)

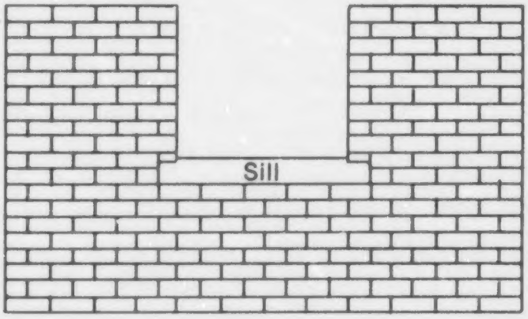
I. Check overhang to be sure it is square with exterior face of wall

J. Check height of sill

K. Continue laying brick to lintel height (Figure 28)

(NOTE: Start by laying jamb units on the pads; maintain specified dimensions for the opening.)

FIGURE 28

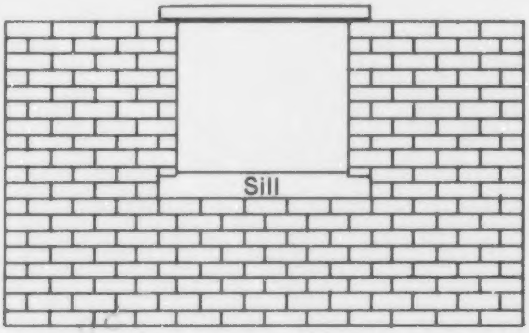


L. Check piers on each side of opening to be sure they are plumb, level, in line, and at proper course height

M. Apply mortar to bearing surface

N. Install lintel so that it has the specified bearing (at least 4 inches on each side) (Figure 29)

FIGURE 29



JOB SHEET #3

O. Level lintel

P. Check height and alignment of lintel

Q. Lay up lintel course, starting at outside corners of wall

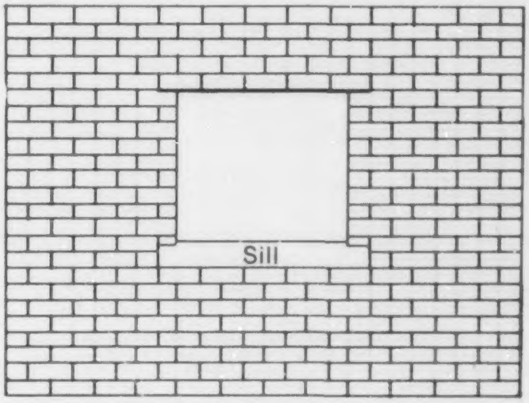
(NOTE: To avoid moving the lintel, allow mortar to set before laying units on the lintel.)

R. After mortar has set sufficiently, lay units from each end of lintel to help distribute weight evenly

(NOTE: Sometimes you must trim the back of brick so that the face of brick will be flush with wall.)

S. Continue laying brick to specified height (Figure 30)

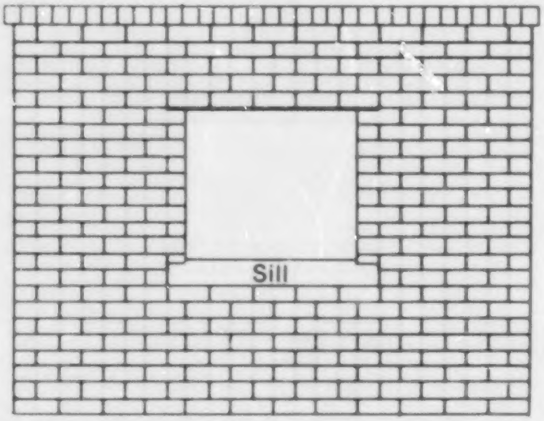
FIGURE 30



T. Clean work area; clean and put away all equipment and materials

SILLS, LINTELS, AND COPINGS
UNIT III

JOB SHEET #4 — LAY BRICK ROWLOCK COPING ON TOP OF BRICK WALL



I. Equipment and materials

- A. Brick trowel
- B. Brick hammer
- C. Modular rule
- D. Bricklayer's level, 4-foot
- E. Jointer
- F. Mortar box and hoe
- G. Water hose and/or bucket
- H. Shovel
- I. Mortarboard and stand
- J. Mortar ingredients or laboratory mortar
- K. 37 standard brick
- L. Brick wall (previously constructed in Job Sheet #3)
- M. Specifications and/or job plans
- N. Bricklayer's line

JOB SHEET #4

II. Procedure

- A. Mix mortar
- B. Apply mortar to top of wall

  (NOTE: Do not furrow the mortar when laying brick in a rowlock position.)
- C. Use trowel to smooth out mortar as close as possible to specified thickness

  (NOTE: Take care when laying brick in a rowlock position; to keep brick from sliding and moving, set them as close as possible to their finished position.)
- D. Lay up both ends of coping, then set line
- E. Lay remainder of brick to the line for remainder of coping
- F. Check bed joint and fill any holes that may have formed under projecting edge
- G. Strike joints as specified
- H. Clean work area; clean and put away all equipment and materials

ABL - 87-A

SILLS, LINTELS, AND COPINGS
UNIT III

TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with sills, lintels, and copings to their correct definitions. Write the correct numbers in the blanks. Definitions are continued on the following page.

______a. Mortar made from sand and lime

______b. Sides of an opening

______c. Precast sill with a 4-inch pad on each end to receive the masonry; set before laying up jamb

______d. Condition of mortar when it has hardened to an arbitrary degree

______e. Single or composite masonry unit that covers width and depth of the opening, provides support for frame, maintains proper jamb width, and aids drainage

______f. Slight indentation made in mortar bed joint with point of trowel

______g. Sill that has been formed, poured in place, then finished

______h. Projection at top part of wall, protruding beyond lower part of wall

______i. Brownish orange, glazed or unglazed, fired clay used to make masonry units

______j. Measurement or size

______k. Horizontal member or beam support placed over a wall opening to carry the weight of the masonry laid over it

______l. Position of brick laid horizontally with end of brick that is facing front of wall having more height than width

1. Furrow
2. Dimension
3. Coping
4. Overhang
5. Sill
6. Laboratory mortar
7. Lintel
8. Slip sill
9. Set
10. Rowlock
11. Cast-in-place sill
12. Terra-cotta
13. Lug sill
14. Jamb

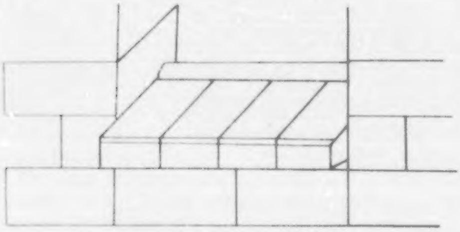
TEST

_____m. Masonry cap or covering laid on top of wall; usually projects from each side of wall to provide protection from moisture penetration

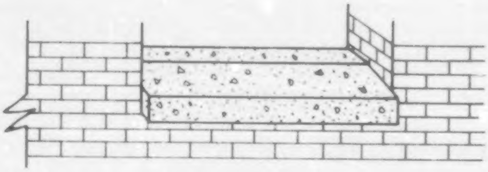
_____n. Precast sill slipped between jambs of opening; placed before or after jambs are laid up

2. Identify the following types of sills. Write the correct names in the blanks.

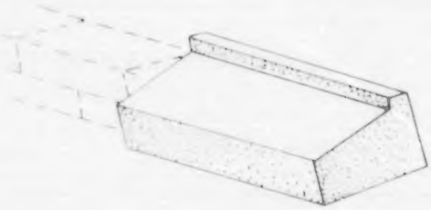
Cast-in-place (concrete)
Special masonry (concrete block)
Lug
Slip
Special masonry (brick rowlock)



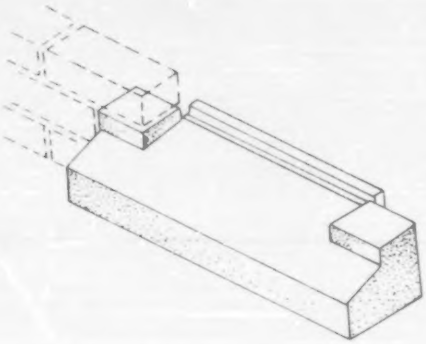
a. ______________________________



b. ______________________________

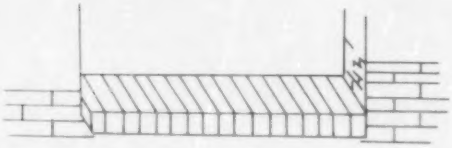


c. ______________________________



d. ______________________________

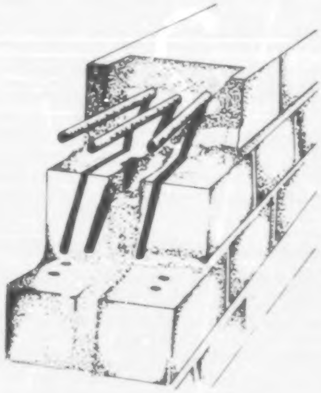
TEST



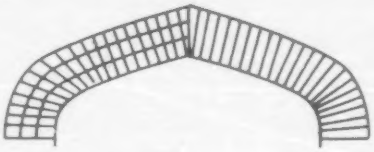
e. ______________________________

3. Identify the following types of lintels. Write the correct names in the blanks. Some names may be used more than once.

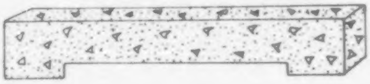
Precast
Angle iron
Arch
Steel I-beam and plate
Poured-in-place over channel iron with reinforced concrete
Bond beam



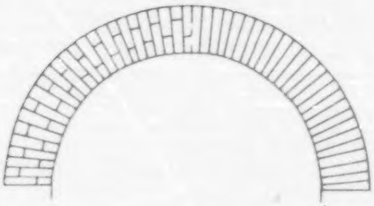
a. ______________________________



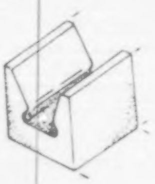
b. ______________________________



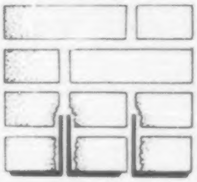
c. ______________________________



d. ____________________

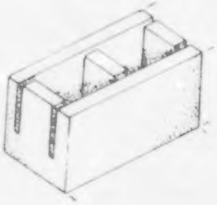


e. ____________________



f. ____________________

TEST



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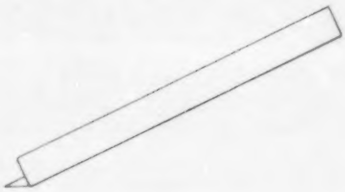

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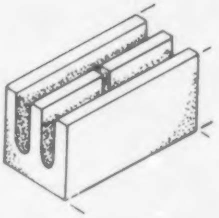
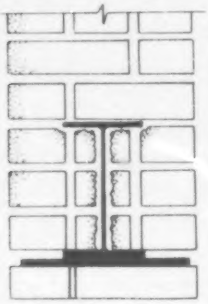


i. ____________________



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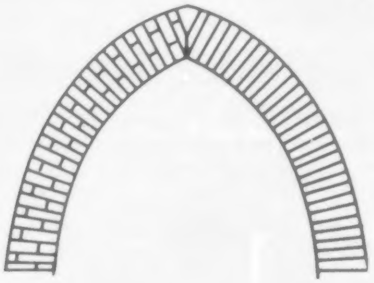
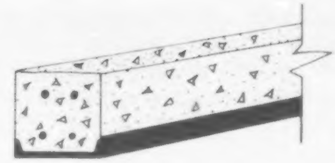
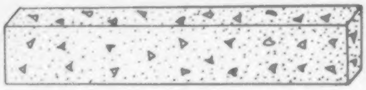


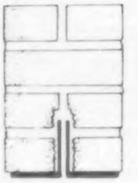
k. ____________________



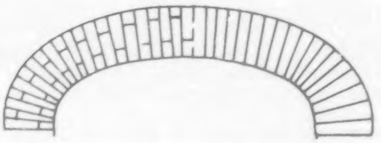
l. ____________________



m. ____________________



n. ____________________



o. ____________________

TEST

4. State five lintel assignments that the bricklayer should be able to perform.

a. ______________________________

b. ______________________________

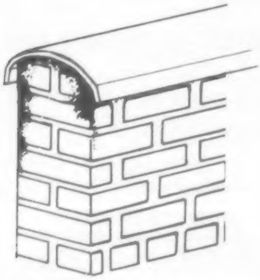
c. ______________________________

d. ______________________________

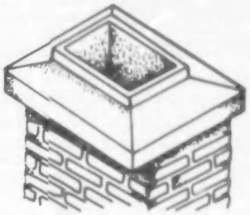
e. ______________________________

5. Identify the following types of copings. Write the correct names in the blanks.

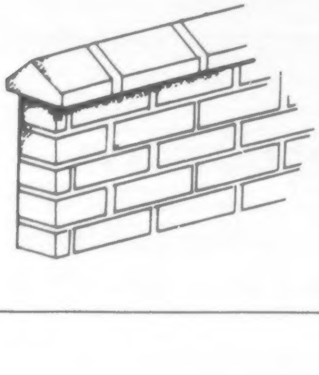
Terra-cotta
Stone
Molded brick
Brick rowlock
Chimney cap (concrete or stone)



a. ______________________

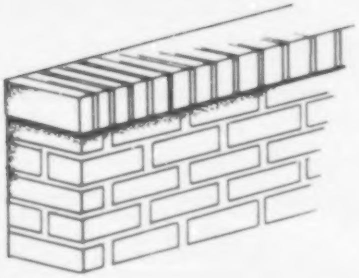


b. ______________________

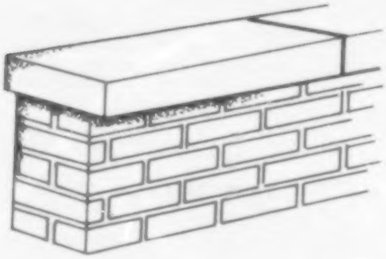


c. ______________________

TEST



d. ______________________________



e. ______________________________

(NOTE: Test question 6 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

6. Demonstrate the ability to

   a. Construct a block wall with a slip sill and precast lintel.

   b. Lay stone coping on top of block wall.

   c. Construct an 8-inch-thick solid brick wall with a lug sill and two angle-iron lintels.

   d. Lay brick rowlock coping on top of brick wall.

SILLS, LINTELS, AND COPINGS
UNIT III

ANSWERS TO TEST

1. a. 6
   b. 14
   c. 13
   d. 9
   e. 5
   f. 1
   g. 11
   h. 4
   i. 12
   j. 2
   k. 7
   l. 10
   m. 3
   n. 8

2. a. Special masonry (concrete block)
   b. Cast-in-place (concrete)
   c. Slip
   d. Lug
   e. Special masonry (brick rowlock)

3. a. Bond beam
   b. Arch
   c. Precast
   d. Arch
   e. Bond beam
   f. Angle iron
   g. Bond beam
   h. Angle iron
   i. Bond beam
   j. Steel I-beam and plate

ANSWERS TO TEST

k. Arch

l. Poured-in-place over channel iron with reinforced concrete

m. Precast

n. Angle iron

o. Arch

4. Answer should include any five of the following

    a. Read plans and specifications
    b. Lay up wall or piers to receive lintel
    c. Construct lintel as specified
    d. Set lintel in proper position with specified bearings
    e. Align lintel within wall
    f. Align adjacent masonry courses
    g. Install flashing as specified
    h. Construct control joints at lintel if specified

5. a. Terra-cotta
    b. Chimney cap (concrete or stone)
    c. Molded brick
    d. Brick rowlock
    e. Stone

6. Performance skills evaluated to the satisfaction of the instructor

CONTROL JOINTS
(EXPANSION JOINTS)
UNIT IV

UNIT OBJECTIVE

After completing this unit, the student should be able to discuss the function of control joints and construct various types of control joints. The student will show this knowledge by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with control joints to their correct definitions.
2. Name the major causes of differential movement.
3. State ways in which differential movement may occur.
4. State methods used to protect structure from differential movement.
5. Select from a list common components of control joints.
6. Discuss the function of control joints in masonry construction.
7. State guidelines for constructing control joints that will meet construction requirements.
8. List factors that determine location and number of control joints to use.
9. State locations where control joints should be used.
10. List types of control joints.
11. List types of water stops used to protect expansion joints from moisture penetration.
12. Demonstrate the ability to
    a. Construct a Michigan control joint, using caulking compound.
    b. Construct a Michigan control joint, using elastomeric seal.
    c. Construct a control joint, using tongue-and-groove block.
    d. Construct a control joint, using Z-tie method.

OBJECTIVE SHEET

e. Construct a control joint, using gasket method.

f. Construct a control joint, using greased-wire method.

g. Construct a control joint, using rake-and-caulk method.

CONTROL JOINTS
(EXPANSION JOINTS)
UNIT IV

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Gather equipment and materials needed for job sheet demonstrations.

   B. Obtain samples of different types of expansion materials.

   C. Provide students with objective sheet.

   D. Discuss unit and specific objectives.

   E. Provide students with information and job sheets.

   F. Discuss information sheet.

   G. Show students samples of different types of expansion materials available.

   H. Provide equipment, materials, and specifications or job plans so that students may complete procedures outlined in job sheets.

   I. Demonstrate and discuss procedures outlined in job sheets.

   J. Teach students techniques, job skills, construction requirements, and trade practices that are important to becoming a good bricklayer.

      (NOTE: This may be a good time to teach students the importance of tooling joints and to teach skills involved in tooling joints correctly.)

   K. Give test.

   L. Complete appropriate section of competency profiles.

      (NOTE: Competency profiles are available from AGC and CIMC.)

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

SUGGESTED ACTIVITIES

D. Job sheets

1. Job Sheet #1 — Construct a Michigan Control Joint, Using Caulking Compound
2. Job Sheet #2 — Construct a Michigan Control Joint, Using Elastomeric Seal
3. Job Sheet #3 — Construct a Control Joint, Using Tongue-and-Groove Block
4. Job Sheet #4 — Construct a Control Joint, Using Z-Tie Method
5. Job Sheet #5 — Construct a Control Joint, Using Gasket Method
6. Job Sheet #6 — Construct a Control Joint, Using Greased-Wire Method
7. Job Sheet #7 — Construct a Control Joint, Using Rake-and-Caulk Method

E. Test

F. Answers to test

III. Unit references

A. Gross, James G., and Harry C. Plummer. *Principles of Clay Masonry Construction,* Student Manual. McLean, Virginia: Brick Institute of America, 1973.

B. Kreh, R. T., Sr. *Masonry Skills.* Albany, New York: Delmar Publishers, Inc., 1982.

C. Taylor, Merlin, and Harland Randolph. *The Bricklayer: Brick and Block Construction,* Vol. III. Washington, D.C.: International Masonry Apprenticeship Trust, 1977.

CONTROL JOINTS
(EXPANSION JOINTS)
UNIT IV

INFORMATION SHEET

I. Terms and definitions

  A. Contraction — Process of drawing up to original or smaller size

  B. Control joint (expansion joint) — Vertical joint built into masonry to isolate one section from another and to isolate wall section from other rigid objects

  C. Cumulative expansion — Increasing process of swelling or enlarging that causes severe stress

  D. Deflection — Process of bending or bowing

  E. Differential movement — Condition in which individual or combined effects of heat, water, or settlement result in cracks or disintegration due to expansion or contraction of different units or parts of the building

  F. Disintegration — Separation into parts or fragments; process of breaking up

  G. Expansion — Process of swelling or enlarging

  H. Flexible — Capable of yielding or bending

  I. Hygroscopic expansion — Process of swelling or enlarging that is caused by moisture absorbed from atmosphere

  J. Reinforcement — Steel embedded in mortar joints in such a manner that the metal and mortar act together to resist forces

  K. Settlement — Process of dropping or sinking

  L. Stress — Intensity of the force developed per unit area within a body in resisting the forces acting on it

  M. Thermal expansion — Process of swelling or enlarging that is caused by heat

II. Major causes of differential movement

  A. Hygroscopic expansion

  B. Thermal expansion and contraction

  C. Settlement

INFORMATION SHEET

III. Ways in which differential movement may occur

   A. Different rate of expansion and contraction of similar material due to difference in exterior and interior temperature and/or moisture

   B. Different rate of expansion and contraction of different materials due to thermal or moisture changes

   C. Difference in thermal and moisture characteristics of structural frame and enclosing walls

   D. Deflection of skeleton frame due to floor loads, wind, or other lateral forces

      (NOTE: Skeleton frames are more flexible than load-bearing walls and will undergo greater deflection.)

   E. Greater temperature movements due to greater variation in temperature of light masonry walls compared to heavier masonry walls used in wall-bearing construction

   F. Cumulative expansion of a long wall intersecting another wall at an angle

      (NOTE: In such a case, cumulative expansion causes lateral movement in the intersected wall.)

   G. Foundation settlement from overloading or freezing when excessive moisture is present

   H. Various other forms of settlement

   I. Movement of reinforced concrete slabs in wall-bearing structures

IV. Methods used to protect structure from differential movement

   A. Construction of control joints

   B. Installation of reinforcement

   C. Specification of materials that will limit expansion and contraction

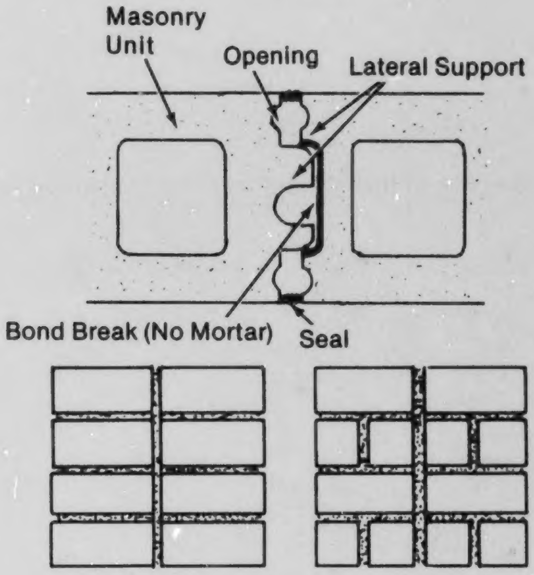
   D. Combination of proper design, materials, and craftsmanship to control settlement

INFORMATION SHEET

V. Common components of control joints (Figure 1)

EXAMPLE:

FIGURE 1



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A. Masonry units

B. Opening

C. Lateral support

D. Bond break

E. Seal

VI. Function of control joints in masonry construction — To provide a complete separation in the structure in order to relieve restrained stresses caused by temperature changes, moisture changes, or settlement

VII. Guidelines for constructing control joints that will meet construction requirements

A. Lay up units to form a continuous vertical or horizontal joint

B. Maintain uniform control-joint dimensions at all points

C. Lay up control-joint sidewalls and faces so that they are plumb and parallel

INFORMATION SHEET

   D. Keep opening free of materials that might prevent movement

   E. Lay out control joints at specified locations

   F. Adjust pattern bond, if possible, so that head joints fall at control joints

   G. Construct control joint as specified

   H. Finish joints to conform with general wall appearance

VIII. Factors that determine location and number of control joints to use

   A. Length of wall

   B. Architectural details

   C. Materials used

   D. Load-bearing requirements

   E. Local building-code requirements

   F. Experience with buildings in the area

IX. Locations where control joints should be used

   A. Return angles in T-shaped buildings

   B. Return angles in U-shaped buildings

   C. Return angles in L-shaped buildings

   D. Point of major change in width or height of wall

   E. Intervals in low structures built between larger structures

   F. Intervals in freestanding structures

   G. Point where long, low structure abuts a larger building

   H. Point where a new building attaches to an existing building

   I. One or both sides of wall openings

   J. Continuation of joints in foundations

   K. Chases and recesses for piping, columns, and fixtures

   L. Wall intersections

INFORMATION SHEET

X. Types of control joints

   A. Michigan

   B. Tongue-and-groove block

   C. Z-tie

   D. Gasket

   E. Preformed seal

   F. Greased wire

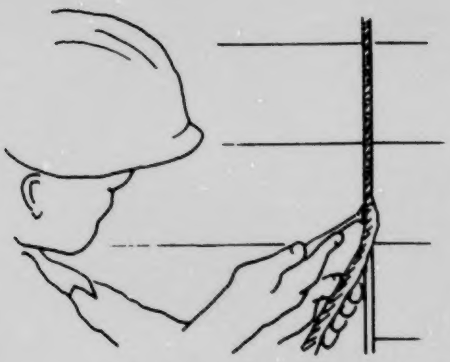
   G. Rake and caulk

XI. Types of water stops used to protect expansion joints from moisture penetration (Figures 2-4)

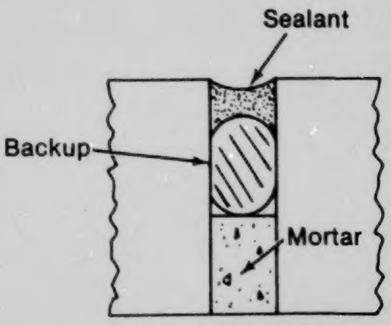
   A. Sealant

   EXAMPLE:

FIGURE 2



Placing Backup



Sealing Control Joint

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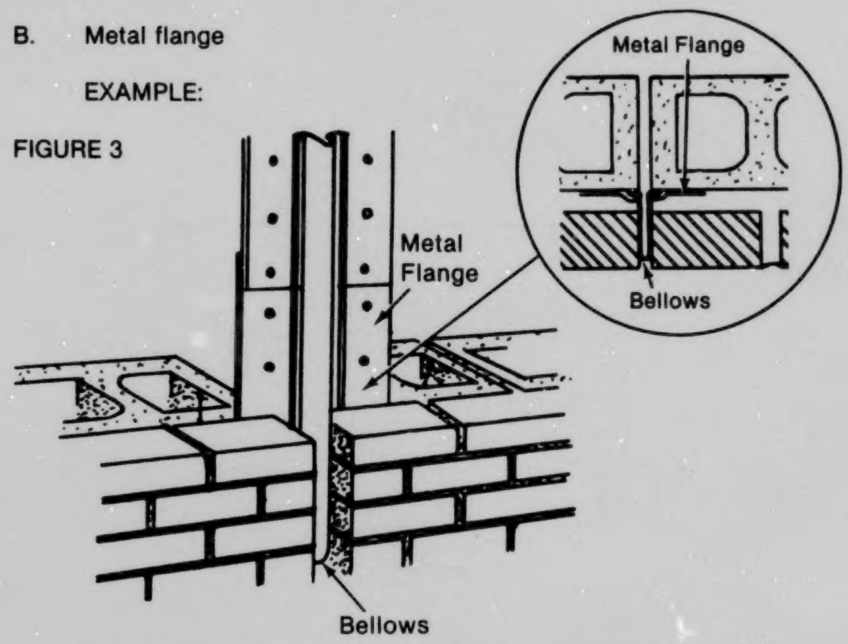
INFORMATION SHEET

B. Metal flange

EXAMPLE:

FIGURE 3


Metal Flange
Bellows
Metal
Flange
Bellows

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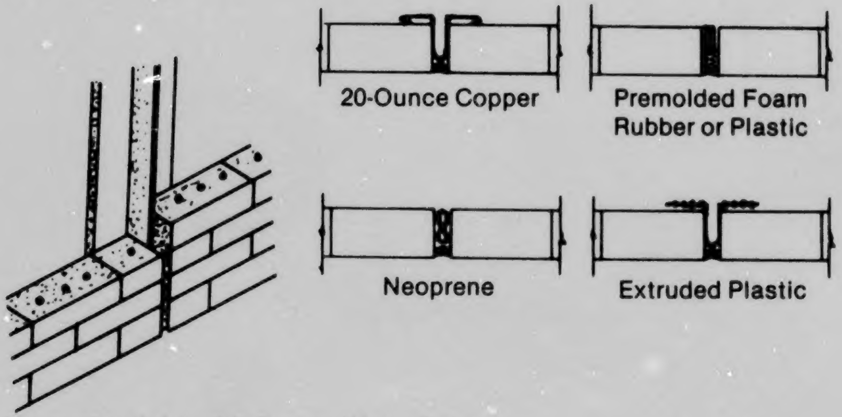
C. Copper or plastic

EXAMPLE:

FIGURE 4


20-Ounce Copper
Premolded Foam
Rubber or Plastic
Neoprene
Extruded Plastic

Expansion Joint with Copper Water Stop

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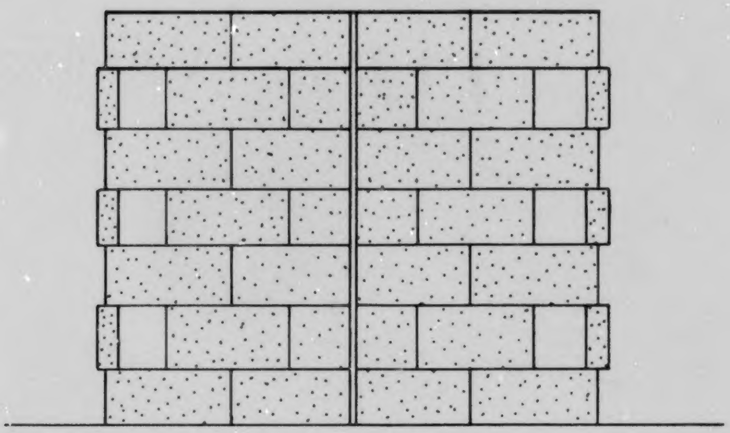
CONTROL JOINTS
(EXPANSION JOINTS)
UNIT IV

JOB SHEET #1 — CONSTRUCT A MICHIGAN CONTROL JOINT, USING CAULKING COMPOUND



I. Equipment and materials

- A. Brick trowel
- B. Brick hammer
- C. Bricklayer's level
- D. Jointer
- E. Utility knife
- F. Caulking gun
- G. Mortarboard and stand
- H. 22 full stretcher blocks, 6 halves, and 6 scraps
- I. Mortar
- J. Building paper or felt paper
- K. Caulking compound
- L. Mortar box
- M. Hoe
- N. Square-point shovel

JOB SHEET #1

O. 5-gallon bucket and water

P. Specifications provided by instructor

II. Procedure

A. Lay out wall according to specifications

B. Mix mortar

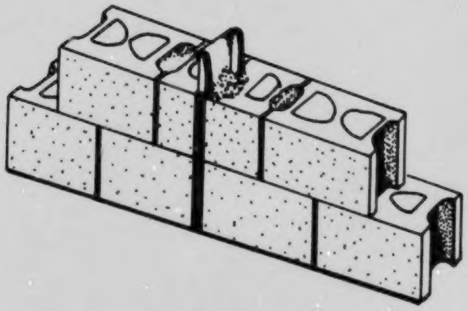
C. Lay up two courses of wall on both sides of control joint

(NOTE: Maintain proper dimensions; be sure that face and ends of block are straight and plumb.)

D. Cut and place building paper in control-joint core to separate the units (Figure 5)

(NOTE: The building paper will keep the mortar from bonding to the units on one side of the control joint. The mortar forms a key that provides lateral support for the wall at this point.)

FIGURE 5



E. Fill core of control joint with mortar

F. Continue laying up block and filling core of control joint until last course is laid

(NOTE: Be sure to overlap building paper 4 to 6 inches to ensure continuous separation.)

G. Tool all joints as specified

JOB SHEET #1

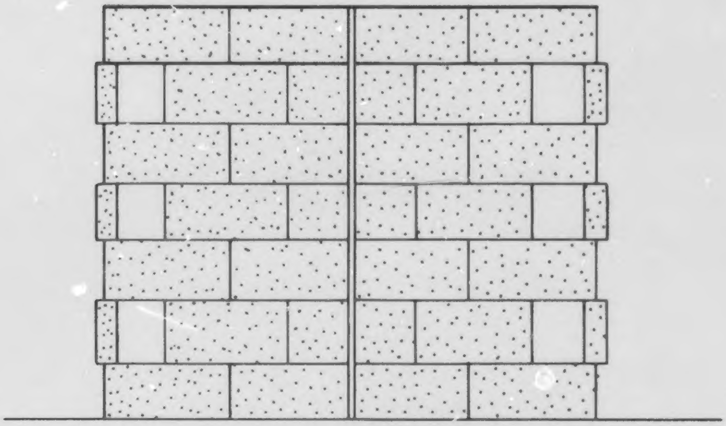
H. When mortar has set and is dry, start at bottom of wall and use caulking compound to fill vertical head joints on exterior and interior wall faces

(NOTE: The caulking will ensure a proper seal if installed properly and the surface is smoothed to seal the edges.)

I. Clean work area; clean and put away all equipment and materials

CONTROL JOINTS
(EXPANSION JOINTS)
UNIT IV

JOB SHEET #2 — CONSTRUCT A MICHIGAN CONTROL JOINT, USING ELASTOMERIC SEAL



I. Equipment and materials

- A. Brick trowel
- B. Brick hammer
- C. Bricklayer's level
- D. Jointer
- E. Utility knife
- F. Mortarboard and stand
- G. Mortar box
- H. Hoe
- I. Square-point shovel
- J. 5-gallon bucket and water
- K. 22 full stretcher blocks, 6 halves, and 6 scraps
- L. Mortar

JOB SHEET #2

M. Building paper or felt paper

N. Elastomeric seal, 5-foot piece

O. Specifications provided by instructor

II. Procedure

A. Lay out wall according to specifications

B. Mix mortar

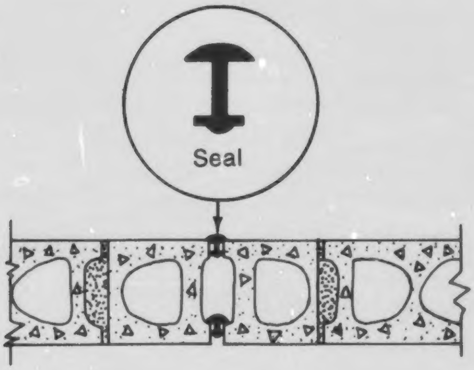
C. Lay up first course of wall on one side of control joint

D. Stick seal to ears on each side of the block at control joint

(NOTE: Sometimes it is necessary to use a parge coat to hold seal in place until other side is laid up. Some seals have an adhesive on one side to stick to masonry units.)

E. Lay up first course on opposite side of control joint by shoving the blocks into position to compress the seal (Figure 6)

FIGURE 6



F. Use procedure in steps C through E to lay second block course

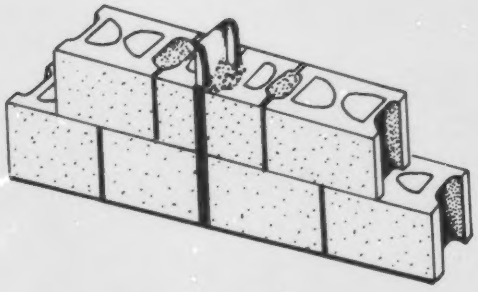
(NOTE: Maintain proper dimensions; be sure that face and ends of block are straight and plumb.)

JOB SHEET #2

G. Cut and place building paper in control-joint core to separate the units (Figure 7)

(NOTE: The building paper will keep the mortar from bonding to the units on one side of the control joint.)

FIGURE 7



H. Fill core of control joint with mortar

I. Continue laying up block, inserting seal, and filling core of control joint until last course is laid

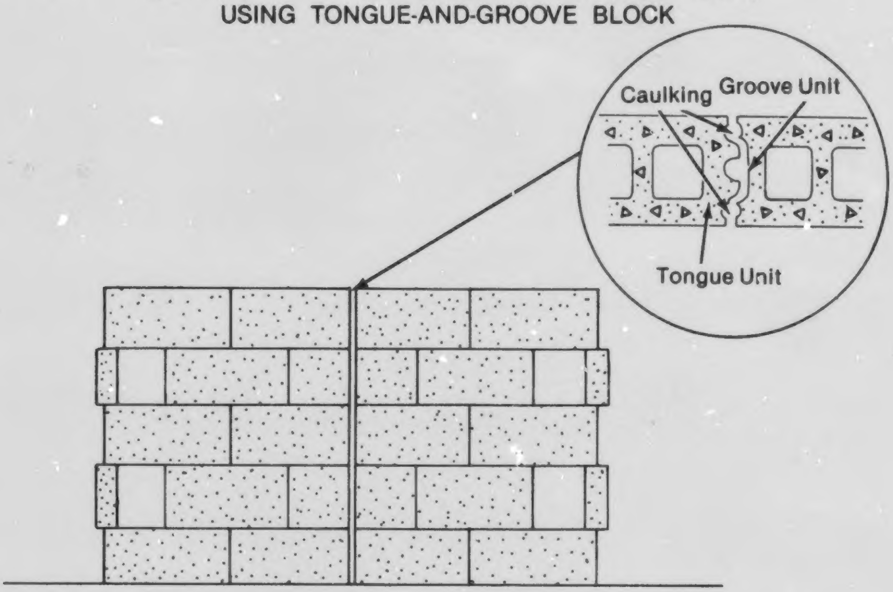
(NOTE: Be sure to overlap building paper 4 to 6 inches to ensure continuous separation.)

J. Tool all joints as specified

K. Clean work area; clean and put away all equipment and materials

CONTROL JOINTS
(EXPANSION JOINTS)
UNIT IV

JOB SHEET #3 — CONSTRUCT A CONTROL JOINT, USING TONGUE-AND-GROOVE BLOCK



I. Equipment and materials

- A. Brick trowel
- B. Brick hammer
- C. Bricklayer's level
- D. Jointer
- E. Mortarboard and stand
- F. Mortar box
- G. Hoe
- H. Square-point shovel
- I. 5-gallon bucket and water
- J. 6 full tongue-and-groove blocks, 10 stretcher blocks, 4 halves, and 4 scraps
- K. Mortar

JOB SHEET #3

L. Caulking gun and caulking compound

M. Specifications provided by instructor

II. Procedure

A. Lay out pattern bond so that proper units will be placed at control joint

B. Mix mortar

C. Lay first course of block with a full bed joint

(NOTE: Keep mortar out of center of control joint; mortar droppings may bond the tongue-and-groove units, preventing them from expanding and contracting, and thus defeating their purpose.)

(CAUTION: Carefully bond units in their proper positions. Tongue must be centered in the groove to maintain uniform clearance.)

D. Continue laying blocks in their proper positions until last course is laid

(NOTE: As work progresses, maintain proper clearance, and be sure that face and ends of block are straight and plumb.)

E. Tool all joints as specified

F. After mortar has set and dried, start at bottom of wall and fill vertical joints with caulking compound to a depth of $1/2$ to $3/4$ of an inch

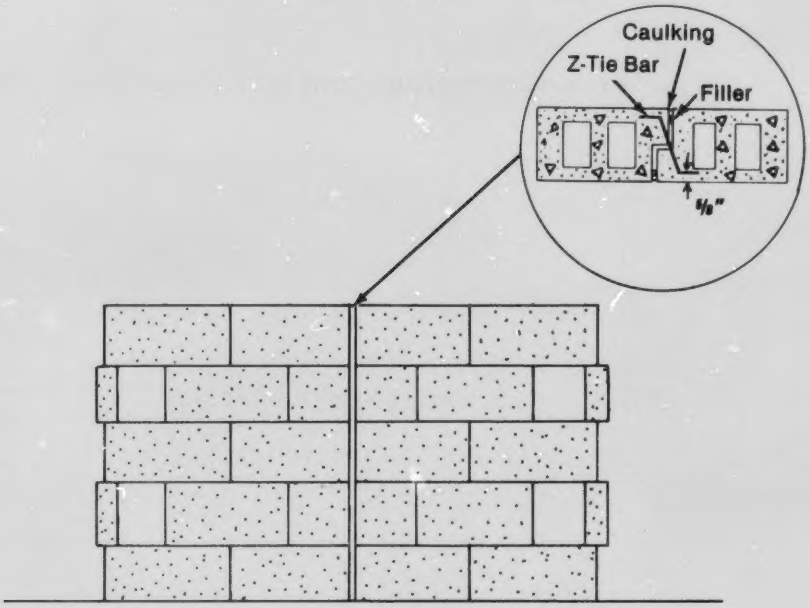
G. Smooth surface of caulking

(NOTE: Caulking will ensure a proper seal if installed properly and surface is smoothed to seal the edges.)

H. Clean work area; clean and put away all equipment and materials

CONTROL JOINTS
(EXPANSION JOINTS)
UNIT IV

JOB SHEET #4 — CONSTRUCT A CONTROL JOINT, USING Z-TIE METHOD



I. Equipment and materials

- A. Brick trowel
- B. Brick hammer
- C. Bricklayer's level
- D. Jointer
- E. Mortarboard and stand
- F. Mortar box
- G. Hoe
- H. Square-point shovel
- I. 5-gallon bucket and water
- J. 6 full blocks and 4 halves
- K. 10 full stretcher blocks and 4 scraps

JOB SHEET #4

- L. Mortar
- M. 3 Z-ties
- N. Caulking gun and caulking compound
- O. Specifications provided by instructor

II. Procedure

- A. Lay out wall according to specificaions
- B. Mix mortar
- C. Lay first course of block, positioning jamb blocks on each side of control joint; maintain proper joint width
- D. Apply full bed of mortar to first course of block
- E. Embed Z-tie in bed joint, positioning tie across control joint with its ends approximately 5/8 inch from wall faces

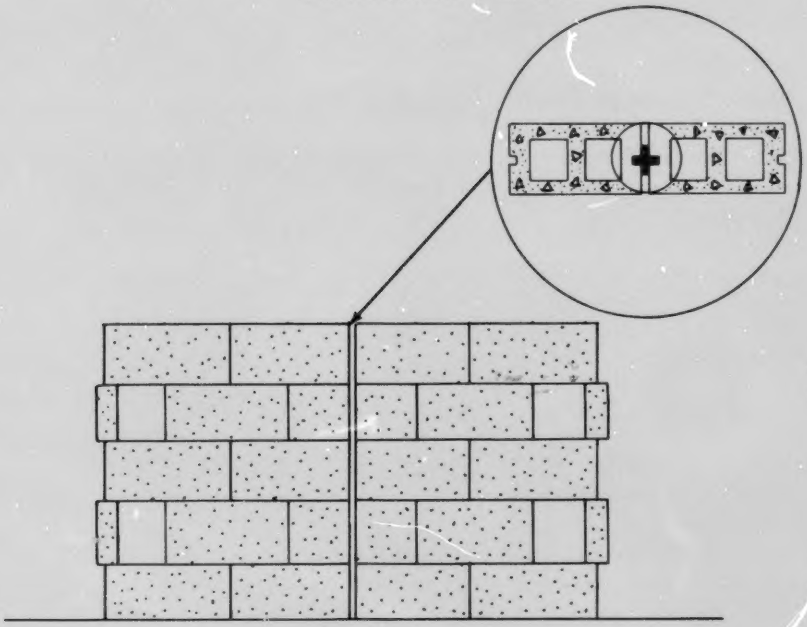
  (NOTE: Mortar must cover the Z-tie to protect it from moisture damage, and mortar must be kept out of the control joint.)
- F. Lay second course of block; maintain proper dimensions and be sure that face and ends of block are straight and plumb

  (NOTE: No Z-tie is used on this course; Z-ties are usually used on every other course and on top course.)
- G. Continue laying block and inserting Z-ties until last course has been laid
- H. Tool all joints as specified
- I. After mortar has set and is dry, start at bottom of wall and fill vertical joint with caulking compound about 1/2 to 3/4 of an inch deep
- J. Smooth surface of caulking

  (NOTE: Caulking will ensure a proper seal if installed properly and surface is smoothed to seal the edges.)
- K. Clean work area; clean and put away all equipment and materials

CONTROL JOINTS
(EXPANSION JOINTS)
UNIT IV

JOB SHEET #5 — CONSTRUCT A CONTROL JOINT, USING GASKET METHOD



I. Equipment and materials

   A. Brick trowel

   B. Brick hammer

   C. Bricklayer's level

   D. Jointer

   E. Mortarboard and stand

   F. Mortar box

   G. Hoe

   H. Square-point shovel

   I. 5-gallon bucket and water

   J. 16 full sash blocks, 4 halves, and 4 scraps

   K. Mortar

JOB SHEET #5

L. Control-joint gasket, 4-foot

M. Caulking gun and caulking compound

N. Specifications provided by instructor

II. Procedure

A. Lay out wall according to specifications

B. Mix mortar

C. Lay up two courses of block

(NOTE: Maintain proper alignment, and be sure that ends and faces of units are straight and plumb.)

D. Slide gasket into notch of sash blocks

(NOTE: The gasket acts as a shear key in the control joint, providing lateral support and holding units in place. The flange of the gasket makes the joint weathertight.)

E. Continue laying block, positioning gasket, and maintaining proper alignment until last course is laid

F. Tool all joints as specified

G. After mortar has set and is dry, start at bottom of wall and fill vertical joint with caulking compound about $^1/_2$ to $^3/_4$ of an inch deep

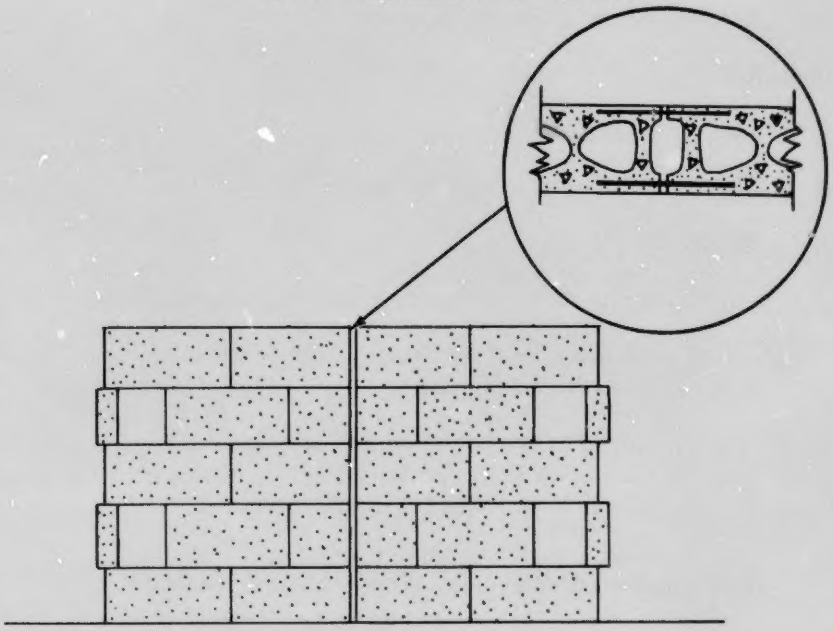
H. Smooth surface of caulking

(NOTE: Caulking will ensure a proper seal if installed properly and surface is smoothed to seal edges.)

I. Clean work area; clean and put away all equipment and materials

CONTROL JOINTS
(EXPANSION JOINTS)
UNIT IV

JOB SHEET #6 — CONSTRUCT A CONTROL JOINT, USING GREASED-WIRE METHOD



I. Equipment and materials

- A. Brick trowel
- B. Brick hammer
- C. Bricklayer's level
- D. Jointer
- E. Mortarboard and stand
- F. Mortar box
- G. Hoe
- H. Square-point shovel
- I. 5-gallon bucket and water
- J. 16 full stretcher blocks, 4 halves, and 4 scraps
- K. Mortar

JOB SHEET #6

L. 6 No. 6 smooth wire rods, 16 inches long

M. Caulking gun and caulking compound

N. Container of general-purpose grease

O. Specifications provided by instructor

II. Procedure

A. Lay out wall according to specifications

B. Mix mortar

C. Lay up first course of wall on each side of control joint

(NOTE: Maintain proper dimensions, and be sure that face and ends of block are straight and plumb.)

D. Apply a full bed of mortar to first course

E. Apply a heavy coat of grease to two wire rods

(NOTE: Grease prevents the wire from bonding to the mortar and allows the wire to slide as the wall moves. The wire also provides lateral stability at the expansion joint.)

F. Embed greased wire rods in bed joint on each side of the wall, centered across control joint

(NOTE: The mortar will hold wires in place and protect them from weathering. Be sure that the wires are completely covered with mortar and that mortar is kept out of the control joint.)

G. Lay second and third courses of block

H. Insert greased wire rods

I. Continue laying block and inserting greased wire rods as specified until last course is laid

J. Tool all joints as specified

K. After mortar has set and is dry, start at bottom of wall and fill vertical joint with caulking compound about 1/2 to 3/4 of an inch deep

JOB SHEET #6

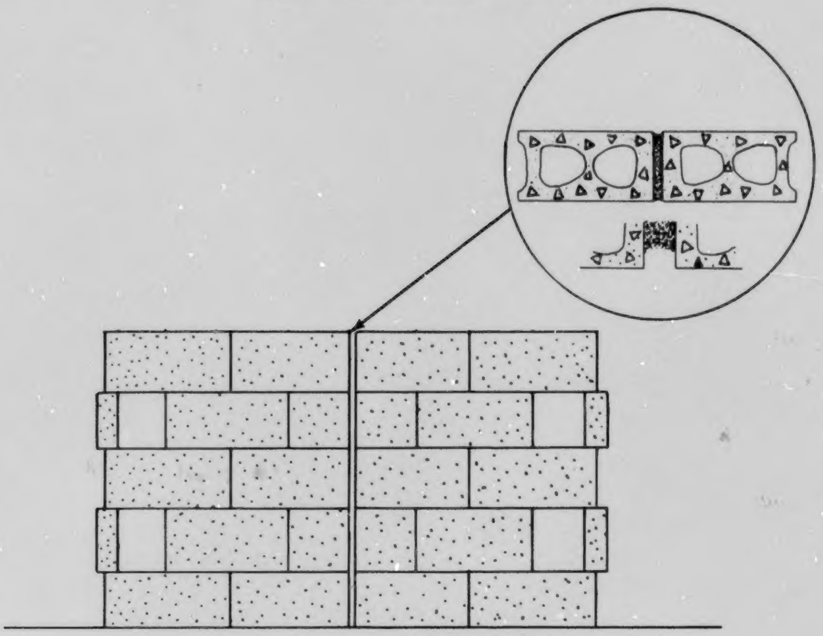
L. Smooth surface of caulking

(NOTE: Caulking will ensure a proper seal if installed properly and surface is smoothed to seal the edges.)

M. Clean work area; clean and put away all equipment and materials

CONTROL JOINTS
(EXPANSION JOINTS)
UNIT IV

JOB SHEET #7 — CONSTRUCT A CONTROL JOINT, USING RAKE-AND-CAULK METHOD



I. Equipment and materials

- A. Brick trowel
- B. Brick hammer
- C. Bricklayer's level
- D. Jointer
- E. Joint raker
- F. Mortarboard and stand
- G. Mortar box
- H. Hoe
- I. Square-point shovel
- J. 5-gallon bucket and water
- K. 6 full corner and stretcher blocks and 4 halves

JOB SHEET #7

L. 10 full stretcher blocks and 4 scraps

M. Mortar

N. Caulking gun and caulking compound

C. Specifications provided by instructor

II. Procedure

A. Lay out wall according to specifications

B. Mix mortar

C. Lay first course of block, using corner block on each side of control joint

(NOTE: For this control joint, full bed and head joints are used to form the continuous vertical control joint.)

D. Continue laying block until last course is laid, maintaining proper dimensions and being sure that face and ends of block are straight and plumb

(NOTE: In this type of control joint, the units are bonded with full head and bed joints, and no reinforcement is used. To ensure lateral stability, the wall must be anchored or bonded to the bond beam, diaphragm, foundation, floor, or roof in strict accordance with the plans and specifications.)

E. After mortar has become "thumbprint" hard, rake it from exterior and interior control joint to a depth of $^3/_4$ inch

F. After mortar has set and is dry, start at bottom of wall and fill vertical joint with caulking compound

G. Smooth surface of caulking

(NOTE: Caulking will ensure a proper seal if installed properly and surface is smoothed to seal the edges.)

H. Clean work area; clean and put away all equipment and materials

ABL - 125-A

CONTROL JOINTS
(EXPANSION JOINTS)
UNIT IV

TEST

NAME ________________________ SCORE ____________

1. Match terms associated with control joints to their correct definitions. Write the correct numbers in the blanks.

_____a. Separation into parts or fragments; process of breaking up

_____b. Process of bending or bowing

_____c. Process of swelling or enlarging

_____d. Process of dropping or sinking

_____e. Process of drawing up to original or smaller size

_____f. Increasing process of swelling or enlarging that causes severe stress

_____g. Vertical joint built into masonry to isolate one section from another and to isolate wall section from other rigid objects

_____h. Capable of yielding or bending

_____i. Intensity of the force developed per unit area within a body in resisting the forces acting on it

_____j. Process of swelling or enlarging that is caused by heat

_____k. Condition in which individual or combined effects of heat, water, or settlement result in cracks or disintegration due to expansion or contraction of different units or parts of the building

_____l. Steel embedded in mortar joints in such a manner that the metal and mortar act together to resist forces

_____m. Process of swelling or enlarging that is caused by moisture absorbed from atmosphere

1. Cumulative expansion
2. Differential movement
3. Disintegration
4. Stress
5. Hygroscopic expansion
6. Contraction
7. Deflection
8. Reinforcement
9. Flexible
10. Expansion
11. Thermal expansion
12. Control joint (expansion joint)
13. Settlement

TEST

2. Name the major causes of differential movement.

a. ______________________________

b. ______________________________

c. ______________________________

3. State five ways in which differential movement may occur.

a. ______________________________

____

____

b. ______________________________

____

____

c. ______________________________

____

____

d. ______________________________

____

____

e. ______________________________

____

____

4. State two methods used to protect structure from differential movement.

a. ______________________________

b. ______________________________

TEST

5. Select from the following list common components of control joints. Write an "X" in the blank before each correct answer.

______a. Bond break

______b. Filler

______c. Pattern

______d. Chase

______e. Lateral support

______f. Water stop

______g. Masonry units

6. Discuss the function of control joints in masonry construction.

____

____

____

7. State four guidelines for constructing control joints that will meet construction requirements.

a. ____

____

b. ____

____

c. ____

____

d. ____

____

TEST

8. List three factors that determine location and number of control joints to use.

   a. ______________________________

   b. ______________________________

   c. ______________________________

9. State six locations where control joints should be used.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

   e. ______________________________

   f. ______________________________

10. List four types of control joints.

    a. ______________________________

    b. ______________________________

    c. ______________________________

    d. ______________________________

11. List two types of water stops used to protect expansion joints from moisture penetration.

    a. ______________________________

    b. ______________________________

TEST

(NOTE: Test question 12 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

12. Demonstrate the ability to

    a. Construct a Michigan control joint, using caulking compound.

    b. Construct a Michigan control joint, using elastomeric seal.

    c. Construct a control joint, using tongue-and-groove block.

    d. Construct a control joint, using Z-tie method.

    e. Construct a control joint, using gasket method.

    f. Construct a control joint, using greased-wire method.

    g. Construct a control joint, using rake-and-caulk method.

CONTROL JOINTS
(EXPANSION JOINTS)
UNIT IV

ANSWERS TO TEST

1. a. 3
   b. 7
   c. 10
   d. 13
   e. 6
   f. 1
   g. 12
   h. 9
   i. 4
   j. 11
   k. 2
   l. 8
   m. 5

2. a. Hygroscopic expansion
   b. Thermal expansion and contraction
   c. Settlement

3. Answer should include any five of the following
   a. Different rate of expansion and contraction of similar material due to difference in exterior and interior temperature and/or moisture
   b. Different rate of expansion and contraction of different materials due to thermal or moisture changes
   c. Difference in thermal and moisture characteristics of structural frame and enclosing walls
   d. Deflection of skeleton frame due to floor loads, wind, or other lateral forces
   e. Greater temperature movements due to greater variation in temperature of light masonry walls compared to heavier masonry walls used in wall-bearing construction
   f. Cumulative expansion of a long wall intersecting another wall at an angle

ANSWERS TO TEST

- g. Foundation settlement from overloading or freezing when excessive moisture is present
- h. Various other forms of settlement
- i. Movement of reinforced concrete slabs in wall-bearing structures

4. Answer should include any two of the following
   - a. Construction of control joints
   - b. Installation of reinforcement
   - c. Specification of materials that will limit expansion and contraction
   - d. Combination of proper design, materials, and craftsmanship to control settlement

5. a, e, g

6. Discussion should include the following

   To provide a complete separation in the structure in order to relieve restrained stresses caused by temperature changes, moisture changes, or settlement

7. Answer should include any four of the following
   - a. Lay up units to form a continuous vertical or horizontal joint
   - b. Maintain uniform control-joint dimensions at all points
   - c. Lay up control-joint sidewalls and faces so that they are plumb and parallel
   - d. Keep opening free of materials that might prevent movement
   - e. Lay out control joints at specified locations
   - f. Adjust pattern bond, if possible, so that head joints fall at control joints
   - g. Construct control joint as specified
   - h. Finish joints to conform with general wall appearance

ANSWERS TO TEST

8. Answer should include any three of the following

a. Length of wall

b. Architectural details

c. Materials used

d. Load-bearing requirements

e. Local building-code requirements

f. Experience with buildings in the area

9. Answer should include any six of the following

a. Return angles in T-shaped buildings

b. Return angles in U-shaped buildings

c. Return angles in L-shaped buildings

d. Point of major change in width or height of wall

e. Intervals in low structures built between larger structures

f. Intervals in freestanding structures

g. Point where long, low structure abuts a larger building

h. Point where a new building attaches to an existing building

i. One or both sides of wall openings

j. Continuation of joints in foundations

k. Chases and recesses for piping, columns, and fixtures

l. Wall intersections

10. Answer should include any four of the following

a. Michigan

b. Tongue-and-groove block

c. Z-tie

ANSWERS TO TEST

- d. Gasket
- e. Preformed seal
- f. Greased wire
- g. Rake and caulk

11. Answer should include any two of the following
    - a. Sealant
    - b. Metal flange
    - c. Copper or plastic

12. Performance skills evaluated to the satisfaction of the instructor

CUT STONE AND ASHLAR STONE
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to list types of cut stone, identify types of stone bonds and patterns, and construct stone walls using various types of bonds. The student will show this knowledge by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with cut stone and ashlar stone.
2. Select from a list reasons for using cut stone or ashlar stone.
3. Name types of ashlar stone.
4. List types of cut stone derived from different classifications of rock.
5. Identify types of stone bonds and ashlar patterns.
6. State precautions to observe when unloading and storing stone.
7. Describe procedures for laying out stone.
8. State factors to consider when setting stone.
9. State rules to follow in order to secure a good bond.
10. Arrange in order procedures for setting stone.
11. List ways to protect stone during construction.
12. State factors to consider when selecting type of stone and pattern to use.
13. State functions of mortar joints.
14. Demonstrate the ability to
    a. Construct a 5-by-5-foot sample panel with wall bond, random-coursed sandstone.
    b. Construct a section of wall with alternate narrow- and thick-coursed ashlar.
    c. Construct a section of wall with broken bond two-against-one.
    d. Construct a section of wall with broken bond three-against-one.

CUT STONE AND ASHLAR STONE
UNIT I

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Order materials planned to supplement unit.

      1. *Contemporary Architecture and Indiana Limestone,* 18 min., 35 mm, Color Slide/Tape, 1981.

      2. *Designing with Indiana Limestone,* 35 mm, Color Slide, 1983.

      (NOTE: These media are available from Indiana Limestone Institute of America, Inc., Stone City Bank Building, Suite 400, Bedford, Indiana 47421.)

   B. Gather samples of cut stone and ashlar stone.

   C. Provide students with objective sheet.

   D. Discuss unit and specific objectives.

   E. Provide students with information and job sheets.

   F. Discuss information sheet.

   G. Provide students with the necessary techniques, hints, and job skills that are unique to laying cut stone and ashlar stone.

   H. Show students samples of different types of cut stone and ashlar stone.

   I. Take students on a field trip to show them completed cut stone and ashlar stone projects.

   J. Have students practice the procedures for setting stone before trying to actually set stone.

   K. Provide equipment and materials so that students may complete procedures outlined in the job sheets.

   L. Have students practice handling and laying stone before trying to accomplish the job sheets.

   M. Furnish specifications and plans so that students may complete procedures outlined in the job sheets.

   N. Give test.

SUGGESTED ACTIVITIES

O. Complete appropriate section of competency profiles.

(NOTE: Competency profiles are available from AGC and CIMC.)

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Job sheets

1. Job Sheet #1 — Construct a Sample 5-by-5-Foot Panel with Wall Bond, Random-Coursed Sandstone

2. Job Sheet #2 — Construct a Section of Wall with Alternate Narrow- and Thick-Coursed Ashlar

3. Job Sheet #3 — Construct a Section of Wall with Broken Bond Two-Against-One

4. Job Sheet #4 — Construct a Section of Wall with Broken Bond Three-Against-One

E. Test

F. Answers to test

III. Unit references

A. Dalzell, J. Ralph, and Gilbert Townsend. *Masonry Simplified,* Vol. 1. Chicago, Illinois: American Technical Society, 1956.

B. Graham, Frank D., and Thomas J. Emery. *Audel's Masons and Builders Guide #4.* New York, New York: Theo Audel and Co., 1924. Reprinted 1943.

C. Gross, James G., and Harry C. Plummer. *Principles of Clay Masonry Construction.* McLean, Virginia: Brick Institute of America, 1973.

D. *Indiana Limestone Handbook.* Bedford, Indiana: Indiana Limestone Institute of America, Inc., 1982-1983.

E. Ramsey, Charles G., and Harold R. Sleeper. *Architectural Graphic Standards,* 6th Ed. New York: John Wiley and Sons, Inc., 1970.

SUGGESTED ACTIVITIES

F. *Technical Notes on Brick Construction.* McLean, Virginia: Brick Institute of America, 1973.

G. Turcotte, Raymond J. *Bricklaying Curriculum.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1977.

CUT STONE AND ASHLAR STONE
UNIT I

INFORMATION SHEET

I. Terms and definitions

A. Anchor — Any of a variety of metal fasteners used to attach stones to structure and/or to each other

B. Ashlar stone — Squared or cut block of stone, usually with rectangular dimensions

C. Broken ashlar — Stones that vary in size

D. Coping — Masonry unit that forms a cap or finish on top of a wall, pier, or chimney

E. Cornice — Top course of a wall treated as a crowning member that projects out at top of wall

F. Critical path method schedule (CPM schedule) — Form of scheduling operations against time periods and resources

G. Cut stone — Blocks of stone cut to specified dimensions

H. Durability — Ability to exist for a long period of time without significant deterioration

I. Header — Stone having its greatest dimension at right angles to face of wall in which it rests

J. Igneous — Type of rock formed by solidification of molten magma

K. Magma — Molten rock material from which igneous rocks are formed

L. Metamorphic — Type of rock formed from preexisting solid rocks by mineralogical, structural, and chemical changes in response to extreme changes in temperature, pressure, and shearing stress; rocks are more compact and more highly crystalline than source rocks

M. Quoin — Stone at corner of a wall emphasized by size, projection, rustication, or different finish

N. Rustication — Rustic appearance of stone

O. Sample wall — Small panel laid up according to specifications for approval of architect or owner

INFORMATION SHEET

P. Sedimentary — Type of rock formed of inorganic remains or organism fragments transported from their source and deposited elsewhere by water

Q. Sill — Horizontal member at base of a window

R. Slump — To drop, slide, or droop

S. Slump block — Manufactured concrete block, formed by using a wet mix, removing block from form while still wet, and allowing face of block to slump

T. Snecked rubble — Stones set so that mating parts engage in such a way as to fasten or lock together

U. Stratified stone — Stone that has been formed in layers or sheets

II. Reasons for using cut stone or ashlar stone

A. Conform to architectural design

B. Provide aesthetic value

C. Are decorative

D. Are durable

E. Are maintenance free

F. Are available

G. Are preferred by customer

III. Types of ashlar stone

A. Sandstone

B. Limestone

C. Granite

D. Marble

E. Slate

F. Slump block

G. Split-face block

INFORMATION SHEET

IV. Types of cut stone derived from different classifications of rock

A. Igneous

1. Granite

2. Traprock

B. Sedimentary

1. Limestone

2. Sandstone

C. Metamorphic

1. Marble

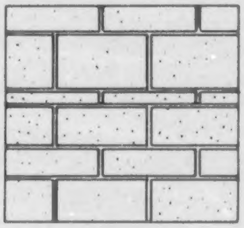
2. Slate

V. Types of stone bonds and ashlar patterns

A. Stone bonds (Figures 1-5)

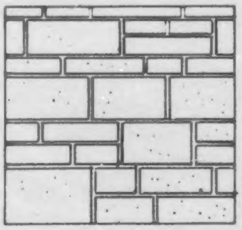
1. Coursed broken bond, ranged

FIGURE 1



2. Coursed broken bond, broken range

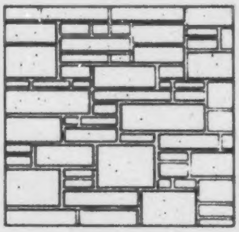
FIGURE 2



INFORMATION SHEET

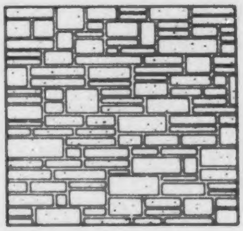
3. Random broken course and range

FIGURE 3



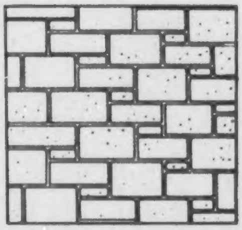
4. Random broken course and range, long stones

FIGURE 4



5. Random-coursed pattern bond

FIGURE 5

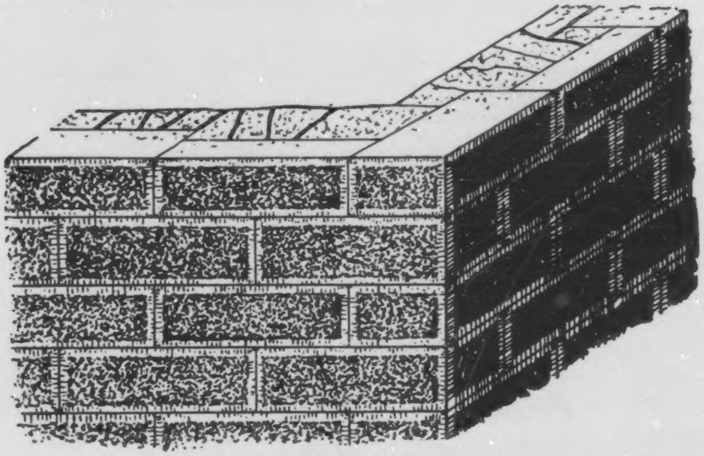


INFORMATION SHEET

B. Ashlar patterns (Figures 6-15)

1. Coursed Ashlar

FIGURE 6



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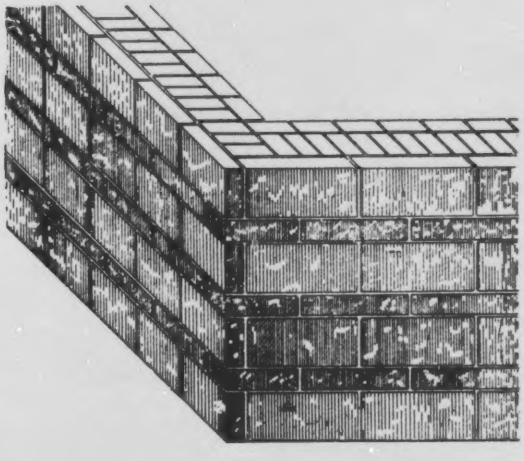
2. Alternate narrow- and thick-coursed ashlar

FIGURE 7



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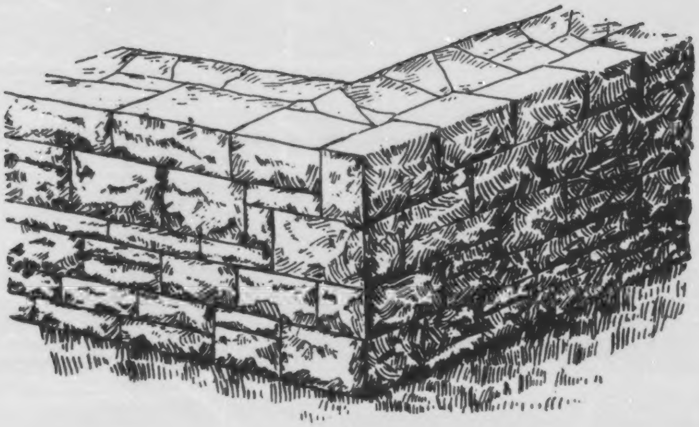
INFORMATION SHEET

3. Broken ashlar

FIGURE 8



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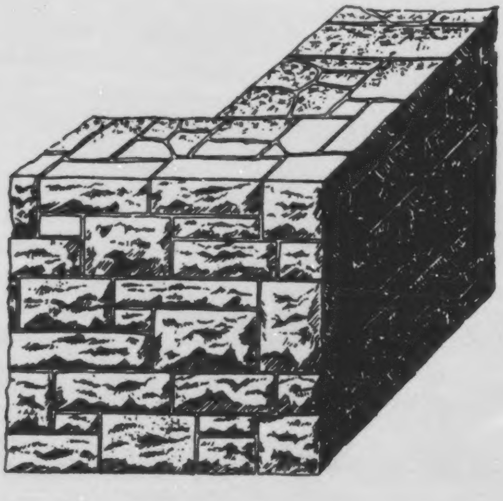
4. Random-coursed broken ashlar

FIGURE 9



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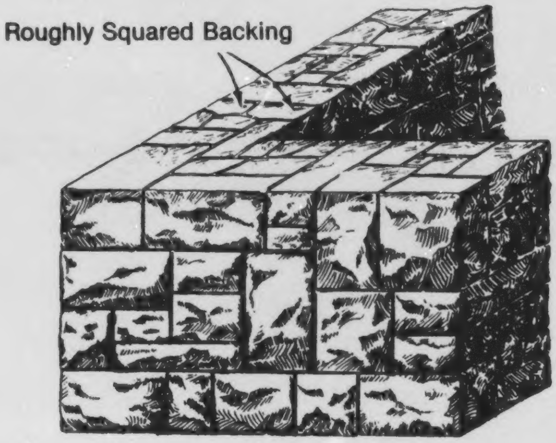
INFORMATION SHEET

5. Uncoursed ashlar

FIGURE 10



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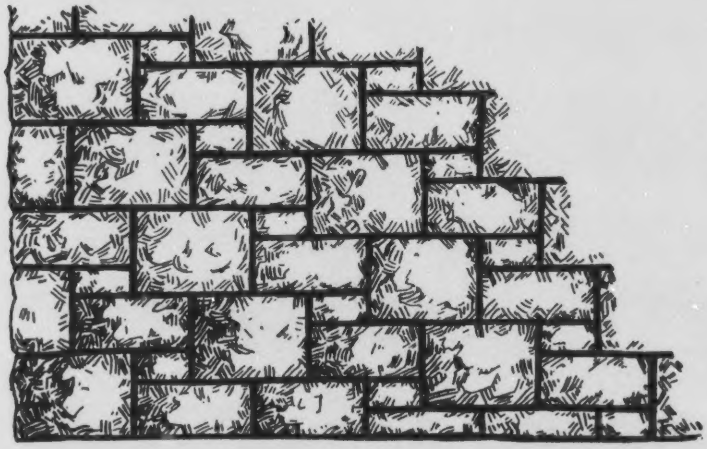
6. Broken bond, two-against-one

FIGURE 11



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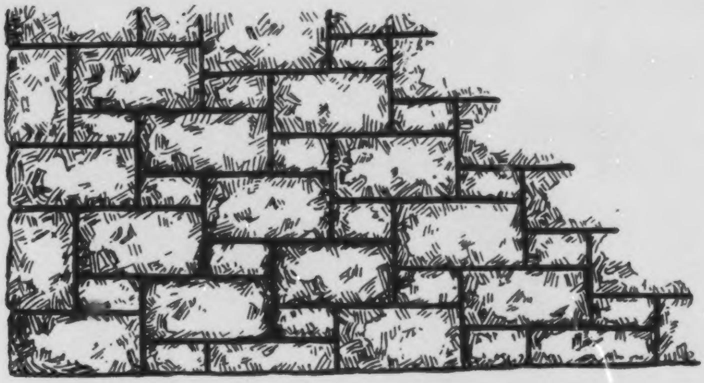
INFORMATION SHEET

7. Broken bond, two-against-two

FIGURE 12



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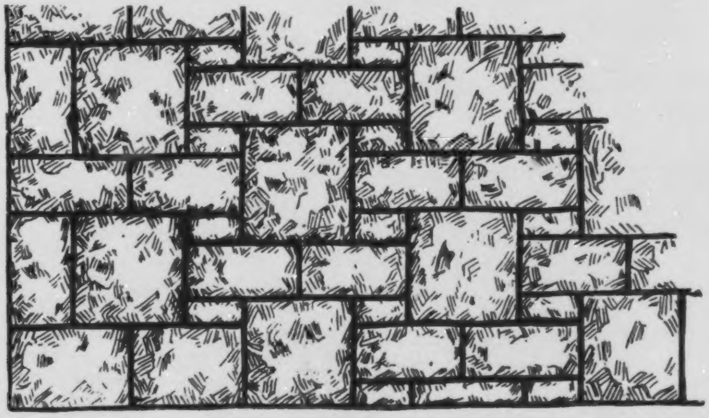
8. Broken bond, three-against-one

FIGURE 13



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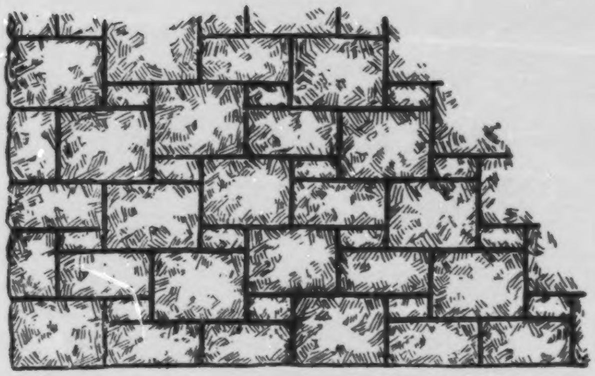
INFORMATION SHEET

9. Broken bond, combination two-against-one and two-against-two

FIGURE 14



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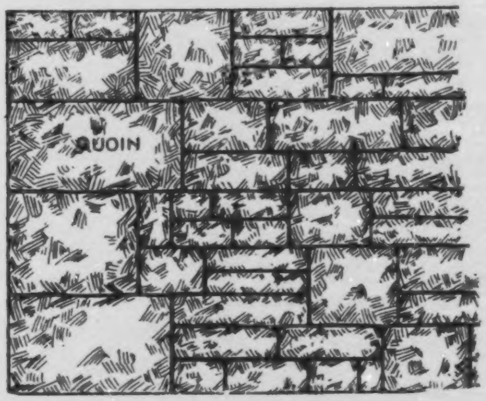
10. Broken bond, irregular or snecked rubble

FIGURE 15



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INFORMATION SHEET

VI. Precautions to observe when unloading and storing stone

- A. Use same spacing material that was delivered with stone
- B. When hoisting stone, be sure to use a signal person
- C. Take special care when storing cornice and projecting stone
- D. Protect finished side and corners of stone
- E. Do not set stone on ground
- F. Protect corners and edges when hoisting stone
- G. Unload stone as near as possible to location for final setting

  (NOTE: Other precautions may be added by instructor.)

VII. Procedures for laying out stone

- A. Position haul truck as near as possible to stones' final location
- B. Inspect stone for damage
- C. Lay stone out as near to its final location as possible

  (NOTE: Do not handle stone any more than is necessary.)
- D. On multistory buildings, place stone at the elevation at which it will be used
- E. Protect stone by covering with a waterproof, nonstaining material

VIII. Factors to consider when setting stone

- A. Type of stone
- B. Type of bond
- C. Equipment needed
- D. Location and number of control joints
- E. CPM schedule
- F. Scheduling of workers and materials

  (NOTE: Stone should not be delivered to the job site too soon. It may be in the way of other crafts and may possibly be damaged.)

INFORMATION SHEET

- G. Safety of crew
- H. Protection of stone after it is set

IX. Rules to follow in order to secure a good bond

- A. Extend headers at least two-thirds the thickness of wall
- B. For foundations, set a header for every 5 square feet of wall
- C. Break vertical joints for each course with the joints of the course below
- D. Lap stone at least 4 inches
- E. Use largest stones in lower course
- F. Set stratified stone on its natural bed

X. Procedures for setting stone

- A. Clean area where wall is to be built
- B. Lay out wall
- C. Install wall ties
- D. Spread mortar
- E. Set stone and reinforcement as specified
- F. Check dimensions, plumb, level, and alignment
- G. Tool joints as specified
- H. Clean stone thoroughly with soap and water

  (NOTE: A fiber scrub brush may be used.)
- I. Drench wall with clean water
- J. Clean area around wall

INFORMATION SHEET

XI. Ways to protect stone during construction

- A. Cover top of walls when stopping work
- B. Keep walls covered during bad weather

  (NOTE: Wall covers should be made of a waterproof, nonstaining material.)

- C. Cover sills, copings, and other horizontal courses with nonstaining wood covering
- D. Build enclosures to protect against bad weather and freezing

XII. Factors to consider when selecting type of stone and pattern to use

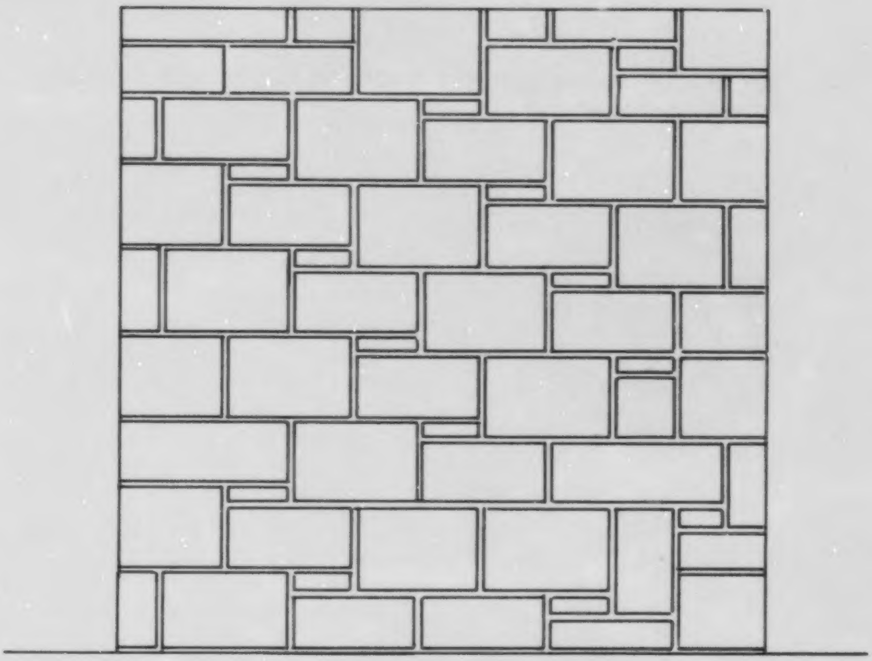
- A. Physical properties
- B. Availability
- C. Cost
- D. Appearance
- E. Location and orientation
- F. Architectural design
- G. Durability
- H. Strength

XIII. Functions of mortar joints

- A. Add to pattern and wall texture
- B. Bond units together, causing reinforcement to act as an integral part of wall
- C. Seal spaces between stones
- D. Compensate for dimensional variations in stone
- E. Provide decorative effect on wall surface

CUT STONE AND ASHLAR STONE
UNIT I

JOB SHEET #1 — CONSTRUCT A 5-BY-5-FOOT SAMPLE PANEL WITH WALL BOND, RANDOM-COURSED SANDSTONE



I. Equipment and materials

- A. Brick trowel
- B. Brick hammer
- C. Mash hammer
- D. Chisel
- E. Jointer
- F. Brickmason's level
- G. Modular rule
- H. Brush

JOB SHEET #1

- I. Mortarboard and stand
- J. Mortar box
- K. Hoe
- L. Square-point shovel
- M. Water bucket
- N. Water
- O. 1 ton cut sandstone
- P. Mortar

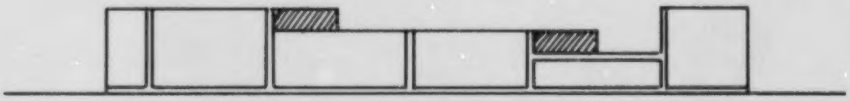
  (NOTE: Instructor will furnish specifications.)

II. Procedure

- A. Lay out panel according to specifications
- B. Mix mortar
- C. Spread mortar for bed joint

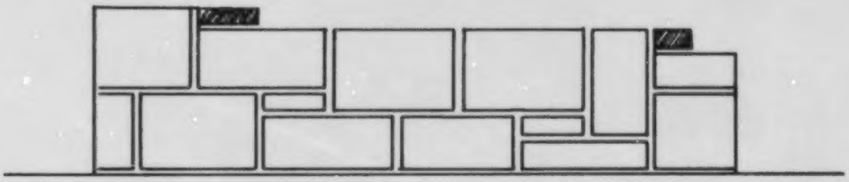
  (NOTE: Refer to specifications for joint size.)
- D. Set first course of stone
- E. Check for plumb, level, alignment, and proper spacing
- F. Set small stones in proper position for desired pattern (Figure 16)

FIGURE 16



- G. Set second course
- H. Set small stones in proper position for desired pattern (Figure 17)

FIGURE 17



JOB SHEET #1

I. Follow plan, and continue setting stone until panel is complete

J. Check panel for plumb, level, alignment and proper spacing as job progresses

K. After mortar has set sufficiently, tool joints as specified

(NOTE: Mortar is set sufficiently when you can press your thumb firmly against the mortar and leave an impression without mortar sticking to your thumb.)

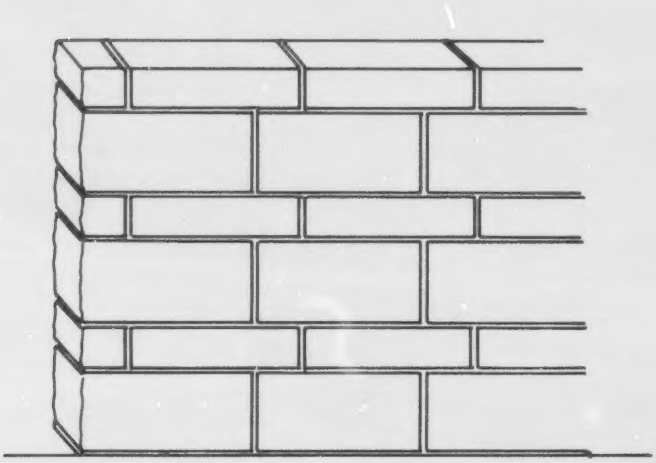
L. Clean excess mortar from face of stone

M. Clean up around base of panel

N. Clean and put away tools and equipment

CUT STONE AND ASHLAR STONE
UNIT I

JOB SHEET #2 — CONSTRUCT A SECTION OF WALL WITH ALTERNATE NARROW- AND THICK-COURSED ASHLAR



I. Equipment and materials

   A. Brick trowel

   B. Brick hammer

   C. Brickmason's level

   D. Modular rule

   E. Mason's line

   F. Line blocks

   G. Jointer and joint rake

   H. Brush

   I. Bolt cutter

   J. Mortarboard and stand

   K. Mortar box

   L. Hoe

JOB SHEET #2

- M. Square-point shovel
- N. Water bucket
- O. Water
- P. Wall ties or reinforcement as specified
- Q. Mortar
- R. 1 ton ashlar stones

  (NOTE: Instructor will furnish specifications.)

II. Procedure

- A. Lay out wall according to specifications
- B. Mix mortar
- C. Spread mortar for bed joint

  (NOTE: Refer to specifications for joint size.)
- D. Set first thick stone to line with corner marks
- E. Continue setting first course of thick stone, maintaining proper head joints, level, plumb, and dimensions
- F. Spread mortar for second course
- G. Install reinforcement

  (NOTE: Be sure that reinforcing material is completely covered with mortar.)
- H. Set second course using narrow stone
- I. Spread mortar for third course
- J. Set third course using thick stone

  (NOTE: Continue maintaining proper joints, level, plumb, and dimensions.)
- K. Spread mortar for fourth course
- L. Set fourth course using narrow stone
- M. Spread mortar for fifth course

JOB SHEET #2

N. Set fifth course using thick stone

O. Spread mortar for sixth or cap course

P. Install reinforcement

(NOTE: Be sure that reinforcing material is completely covered with mortar.)

Q. Set sixth or cap course using narrow stone

R. Recheck wall for proper joints, level, plumb, alignment, and dimensions

S. After mortar has set sufficiently, tool joints as specified

(NOTE: Mortar is set sufficiently when you can press your thumb firmly against the mortar and leave an impression without mortar sticking to your thumb.)

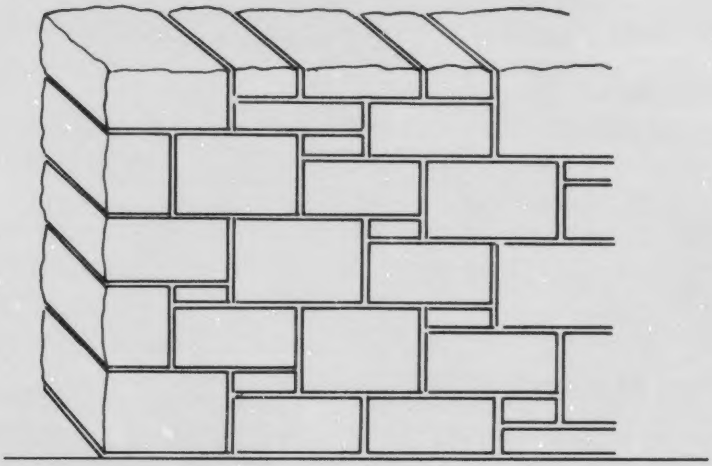
T. Clean stone

U. Clean up area around wall

V. Clean and put away tools and equipment

CUT STONE AND ASHLAR STONE
UNIT I

JOB SHEET #3 — CONSTRUCT A SECTION OF WALL WITH BROKEN BOND TWO-AGAINST-ONE



I. Equipment and materials

   A. Brick trowel

   B. Brick hammer

   C. Brickmason's level

   D. Modular rule

   E. Mash hammer

   F. Chisel

   G. Jointer and joint rake

   H. Brush

   I. Mortarboard and stand

   J. Mortar box

   K. Hoe

JOB SHEET #3

L. Square-point shovel

M. Water bucket

N. Water

O. Wall ties

P. Mortar

Q. 1 ton stones

(NOTE: Instructor will furnish specifications.)

II. Procedure

A. Lay out wall according to specifications

B. Mix mortar

C. Spread mortar for bed joint

(NOTE: Refer to specifications for joint size.)

D. Set first stone to line with corner marks

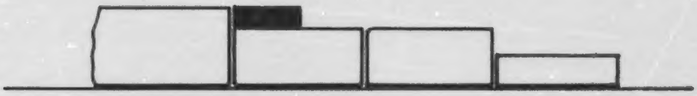
E. Continue setting first course of stone, maintaining proper head joints, level, plumb, and dimensions

(NOTE: Keep finished pattern in mind when choosing and placing stones.)

F. Spread mortar on second stone

G. Set small stone on top of second stone (Figure 18)

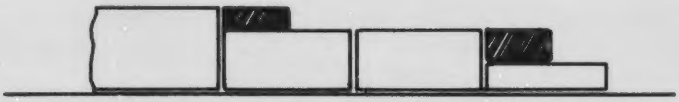
FIGURE 18



JOB SHEET #3

H. Spread mortar and set small stone on top of fourth stone (Figure 19)

FIGURE 19



I. Spread mortar on top of cornerstone

J. Set second cornerstone

K. Spread mortar and set two stones next to second cornerstone

(NOTE: As stone setting progresses, install wall ties as specified.)

L. Follow plan and continue setting stone until wall is complete

M. Continue to maintain proper joints, level, plumb, alignment, pattern, and dimensions

N. After mortar has set sufficiently, tool joints as specified

(NOTE: Mortar is set sufficiently when you can press your thumb firmly against the mortar and leave an impression without mortar sticking to your thumb.)

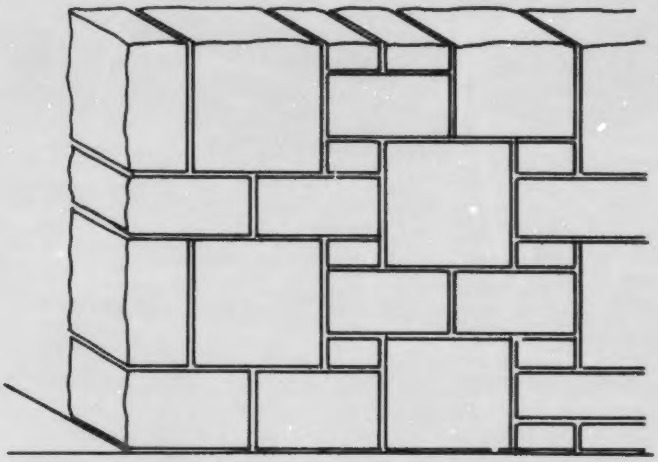
O. Clean stone

P. Clean up area around wall

Q. Clean and put away tools and equipment

CUT STONE AND ASHLAR STONE
UNIT I

JOB SHEET #4 — CONSTRUCT A SECTION OF WALL WITH BROKEN BOND THREE-AGAINST-ONE



I. Equipment and materials

  A. Brick trowel

  B. Brick hammer

  C. Brickmason's level

  D. Modular rule

  E. Mash hammer

  F. Chisel

  G. Jointer and joint rake

  H. Brush

  I. Mortarboard and stand

  J. Mortar box

  K. Hoe

  L. Square-point shovel

JOB SHEET #4

M. Water bucket

N. Water

O. Wall ties

P. Mortar

Q. 1 ton stones

(NOTE: Instructor will furnish specifications.)

II. Procedure

A. Lay out wall according to specifications

B. Mix mortar

C. Spread mortar for bed joint

(NOTE: Refer to specifications for joint size.)

D. Set cornerstone to line with corner marks

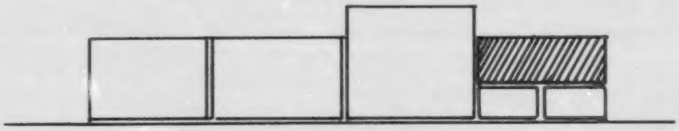
E. Continue setting first course of stone, maintaining proper head joints, level, plumb, and dimensions

(NOTE: Keep finished pattern in mind when choosing and placing stones.)

F. Spread mortar on fourth and fifth stones

G. Set 6-by-12-inch stone on top of fourth and fifth stones (Figure 20)

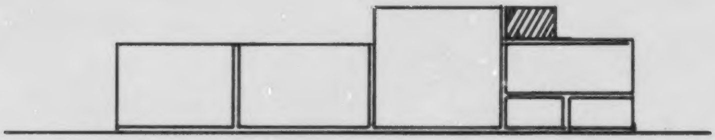
FIGURE 20



JOB SHEET #4

H. Spread mortar on top of this stone; then set 3-by-6-inch stone (Figure 21)

FIGURE 21



I. Spread mortar on top of cornerstone and second stone

J. Set second cornerstone; then set next two stones following pattern

K. Spread mortar and set following two stones

(NOTE: As stone setting progresses, install wall ties as specified.)

L. Follow plan and continue setting stone until wall is complete

M. Recheck wall for proper joints, level, plumb, alignment, and dimensions

N. After mortar has set sufficiently, tool joints as specified

(NOTE: Mortar is set sufficiently when you can press your thumb firmly against the mortar and leave an impression without mortar sticking to your thumb.)

O. Clean stone

P. Clean up area around wall

Q. Clean and put away tools and equipment

CUT STONE AND ASHLAR STONE
UNIT I

TEST

NAME ______________________________ SCORE ______________

1. Match to their correct definitions terms associated with cut stone and ashlar stone. Write the correct numbers in the blanks. Terms and definitions continued on the following page.

_____a. Horizontal member at base of a window

_____b. Form of scheduling operations against time periods and resources

_____c. Top course of a wall treated as a crowning member that projects out at top of wall

_____d. Blocks of stone cut to specified dimensions

_____e. Type of rock formed of inorganic remains or organism fragments transported from their source and deposited elsewhere by water

_____f. Any of a variety of metal fasteners used to attach stones to structure and/or to each other

_____g. Molten rock material from which igneous rocks are formed

_____h. Masonry unit that forms a cap or finish on top of a wall, pier, or chimney

_____i. Type of rock formed from preexisting solid rocks by mineralogical, structural, and chemical changes in response to extreme changes in temperature, pressure, and shearing stress; rocks are more compact and more highly crystalline than source rocks

_____j. Type of rock formed by solidification of molten magma

_____k. Rustic appearance of stone

_____l. Stone at corner of a wall emphasized by size, projection, rustication, or different finish

1. Cornice
2. Anchor
3. Metamorphic
4. Sill
5. Coping
6. Igneous
7. Sedimentary
8. Critical path method schedule (CPM schedule)
9. Magma
10. Cut stone
11. Quoin
12. Rustication

TEST

______m. Manufactured concrete block, formed by using a wet mix, removing block from the form while still wet, and allowing face of block to slump

______n. Squared or cut block of stone, usually with rectangular dimensions

______o. Stone that has been formed in layers or sheets

______p. Stone having its greatest dimension at right angles to face of wall in which it rests

______q. To drop, slide, or droop

______r. Stones that vary in size

______s. Stones set so that mating parts engage in such a way as to fasten or lock together

______t. Small panel laid up according to specifications for approval of architect or owner

______u. Ability to exist for a long period of time without significant deterioration

13. Ashlar stone
14. Broken ashlar
15. Stratified stone
16. Slump block
17. Header
18. Snecked rubble
19. Slump
20. Durability
21. Sample wall

2. Select from the following list reasons for using cut stone or ashlar stone. Write an "X" in the blank before each correct answer.

______a. Provide texture

______b. Are durable

______c. Conform to architectural design

______d. Are structurally strong

______e. Are waterproof

______f. Provide aesthetic value

______g. Are decorative

______h. Are economical

______i. Are maintenance free

______j. Are preferred by customer

______k. Are available

TEST

3. Name five types of ashlar stone.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

4. List one type of cut stone derived from each of the different classifications of rock.

a. Igneous — ____________________

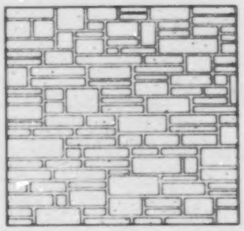
b. Sedimentary — ____________________

c. Metamorphic — ____________________

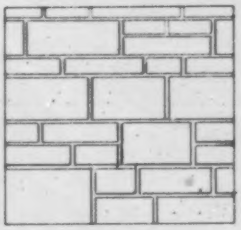
5. Identify the following types of stone bonds and ashlar patterns. Write the correct names in the blanks.

Random broken course and range, long stones
Coursed broken bond, broken range
Random broken course and range
Coursed broken bond, ranged
Random-coursed pattern bond
Broken bond, three-against-one
Broken bond, irregular or snecked rubble
Alternate narrow- and thick-coursed ashlar
Random-coursed broken ashlar
Coursed ashlar
Broken ashlar
Uncoursed ashlar
Broken bond, two-against-one
Broken bond, two-against-two
Broken bond, combination two-against-one and two-against-two

a. Stone bonds

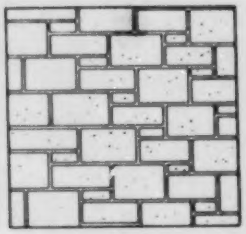


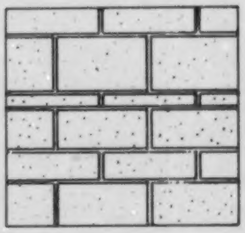
1) ____________________



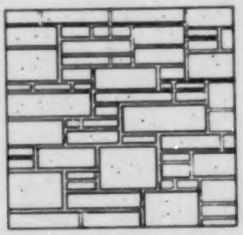
2) ____________________

TEST



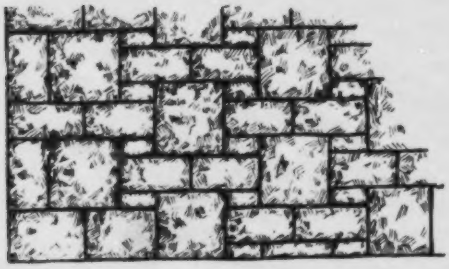


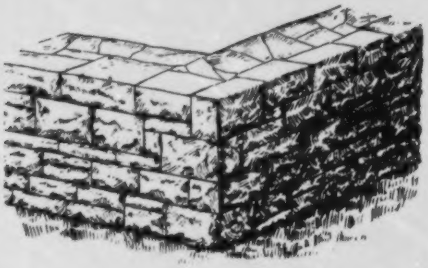
3) ____________________ 4) ____________________



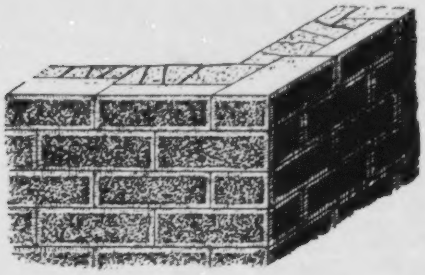
5) ____________________

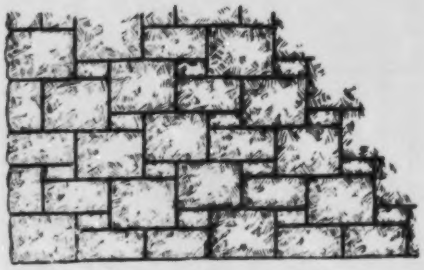
b. Ashlar patterns





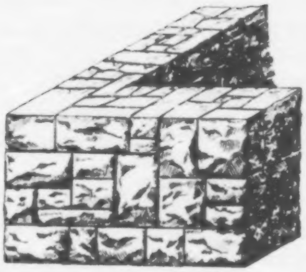
1) ____________________ 2) ____________________



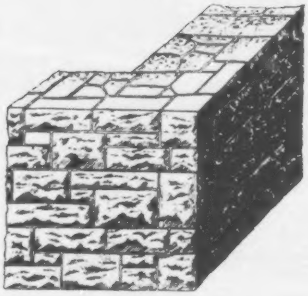


3) ____________________ 4) ____________________

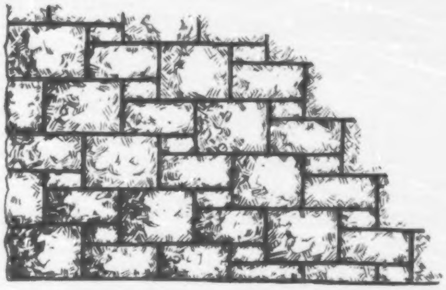
TEST



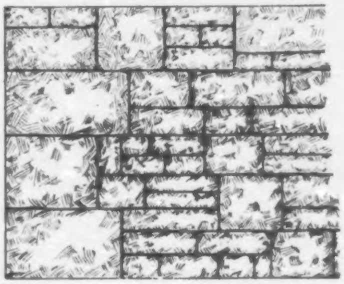
5) ____________________



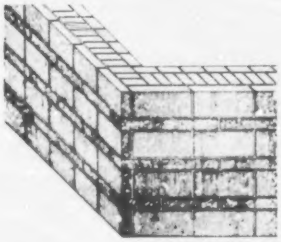
6) ____________________



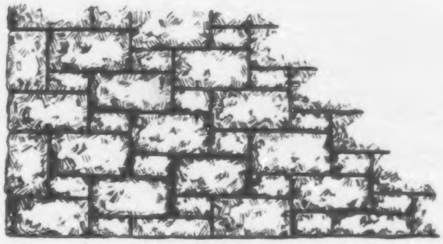
7) ____________________



8) ____________________



9) ____________________



10) ____________________

6. State four precautions to observe when unloading and storing stone.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

TEST

7. Describe procedures for laying out stone.

____

____

____

____

____

____

8. State four factors to consider when setting stone.

a. ____

b. ____

c. ____

d. ____

9. State four rules to follow in order to secure a good bond.

a. ____

b. ____

c. ____

d. ____

10. Arrange in order procedures for setting stone. Write a "1" in the blank before the first procedure, a "2" in the blank before the second procedure, and so on.

______a. Tool joints as specified

______b. Spread mortar

______c. Clean stone thoroughly with soap and water

______d. Lay out wall

______e. Set stone and reinforcement as specified

______f. Drench wall with clean water

______g. Install wall ties

______h. Check dimensions, plumb, level, and alignment

______i. Clean area where wall is to be built

______j. Clean area around wall

TEST

11. List two ways to protect stone during construction.

    a. ______________________________

    ____

    b. ______________________________

    ____

12. State four factors to consider when selecting type of stone and pattern to use.

    a. ______________________________

    b. ______________________________

    c. ______________________________

    d. ______________________________

13. State three functions of mortar joints.

    a. ______________________________

    b. ______________________________

    c. ______________________________

(NOTE: Test question 14 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

14. Demonstrate the ability to

    a. Construct a 5-by-5-foot sample panel with wall bond, random-coursed sandstone.

    b. Construct a section of wall with alternate narrow- and thick-coursed ashlar.

    c. Construct a section of wall with broken bond two-against-one.

    d. Construct a section of wall with broken bond three-against-one.

CUT STONE AND ASHLAR STONE
UNIT I

ANSWERS TO TEST

1.

a.	4	g.	9	m.	16	s.	18
b.	8	h.	5	n.	13	t.	21
c.	1	i.	3	o.	15	u.	20
d.	10	j.	6	p.	17		
e.	7	k.	12	q.	19		
f.	2	l.	11	r.	14		

2. b, c, f, g, i, j, k

3. Answer should include any five of the following
   - a. Sandstone
   - b. Limestone
   - c. Granite
   - d. Marble
   - e. Slate
   - f. Slump block
   - g. Split-face block

4. Answer should include one of the following in each category
   - a. Igneous
     - 1) Granite
     - 2) Traprock
   - b. Sedimentary
     - 1) Limestone

ANSWERS TO TEST

- 2) Sandstone
- c. Metamorphic
  - 1) Marble
  - 2) Slate

5. a. Stone bonds
   - 1) Random broken course and range, long stones
   - 2) Coursed broken bond, broken range
   - 3) Random-coursed pattern bond
   - 4) Coursed broken bond, ranged
   - 5) Random broken course and range

   b. Ashlar patterns
   - 1) Broken bond, three-against-one
   - 2) Broken ashlar
   - 3) Coursed ashlar
   - 4) Broken bond, combination two-against-one and two-against-two
   - 5) Uncoursed ashlar
   - 6) Random-coursed broken ashlar
   - 7) Broken bond, two-against-one
   - 8) Broken bond, irregular or snecked rubble
   - 9) Alternate narrow- and thick-coursed ashlar
   - 10) Broken bond, two-against-two

6. Answer should include any four of the following
   - a. Use same spacing material that was delivered with stone
   - b. When hoisting stone, be sure to use a signal person

ANSWERS TO TEST

c. Take special care when storing cornice and projecting stone

d. Protect finished side and corners of stone

e. Do not set stone on ground

f. Protect corners and edges when hoisting stone

g. Unload stone as near as possible to location for final setting

7. Description should include the following

   a. Position haul truck as near as possible to stones' final location

   b. Inspect stone for damage

   c. Lay stone out as near to its final location as possible

   d. On multistory buildings, place stone at the elevation at which it will be used

   e. Protect stone by covering with a waterproof, nonstaining material

8. Answer should include any four of the following

   a. Type of stone

   b. Type of bond

   c. Equipment needed

   d. Location and number of control joints

   e. CPM schedule

   f. Scheduling of workers and materials

   g. Safety of crew

   h. Protection of stone after it is set

9. Answer should include any four of the following

   a. Extend headers at least two-thirds the thickness of wall

   b. For foundations, set a header for every 5 square feet of wall

ANSWERS TO TEST

c. Break vertical joints for each course with the joints of the course below

d. Lap stone at least 4 inches

e. Use largest stones in lower course

f. Set stratified stone on its natural bed

10.

a.	7	f.	9
b.	4	g.	3
c.	8	h.	6
d.	2	i.	1
e.	5	j.	10

11. Answer should include any two of the following

a. Cover top of walls when stopping work

b. Keep walls covered during bad weather

c. Cover sills, copings, and other horizontal courses with nonstaining wood covering

d. Build enclosures to protect against bad weather and freezing

12. Answer should include any four of the following

a. Physical properties

b. Availability

c. Cost

d. Appearance

e. Location and orientation

f. Architectural design

g. Durability

h. Strength

ANSWERS TO TEST

13. Answer should include any three of the following
    - a. Add to pattern and wall texture
    - b. Bond units together, causing reinforcement to act as an integral part of wall
    - c. Seal spaces between stones
    - d. Compensate for dimensional variations in stone
    - e. Provide decorative effect on wall surface

14. Performance skills evaluated to the satisfaction of the instructor

ROUGH STONE
(RUBBLE)
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to identify types of stone and stone patterns and to lay out and construct stone walls using various types of stone and stone patterns. The student will show this knowledge by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with rough stone.
2. Select from a list reasons for using rough stone.
3. Name types of rough stone.
4. Identify types of rough-stone patterns.
5. Arrange in order procedures for setting rough stone.
6. State methods used to protect stone during construction.
7. State factors to consider when selecting type of stone and pattern to use.
8. Demonstrate the ability to
    a. Construct a stone corner using uncoursed cobweb pattern.
    b. Lay out and construct a section of wall using coursed rubble with bondstones.
    c. Construct a section of wall using uncoursed fieldstone.

ROUGH STONE
(RUBBLE)
UNIT II

SUGGESTED ACTIVITIES

I. Suggested activities

A. Gather equipment and materials for job sheet demonstrations.

B. Gather samples of different types of rough stone.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives

E. Provide students with information and job sheets.

F. Discuss information sheet.

G. Show students samples of different types of rough stone.

H. Take students on field trips to different projects to show them where and how rough stone is used.

I. Have students practice laying rough stone before trying to complete job sheets.

J. Provide equipment and materials necessary to complete procedures in the job sheets.

K. Provide students with the necessary techniques, hints, and job skills that will help them become good stone setters.

L. Provide students with specifications and/or job plans for job sheets.

M. Give test.

N. Complete appropriate section of competency profiles.

(NOTE: Competency profiles are available from AGC and CIMC.)

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Job sheets

1. Job Sheet #1 — Construct a Stone Corner Using Uncoursed Cobweb Pattern

SUGGESTED ACTIVITIES

2. Job Sheet #2 — Lay Out and Construct a Section of Wall Using Coursed Rubble with Bondstones

3. Job Sheet #3 — Construct a Section of Wall Using Uncoursed Fieldstone

E. Test

F. Answers to test

III. Unit reference — Ramsey, Charles G., and Harold R. Sleeper. *Architectural Graphic Standards*, 6th ed. New York: John Wiley and Sons, Inc., 1970.

ROUGH STONE
(RUBBLE)
UNIT II

INFORMATION SHEET

I. Terms and definitions

A. Aesthetic — Relating to or dealing with beautiful or artistic works

B. Bondstone — Stone that extends completely through wall to tie (bond) both sides together

C. Capstone — Top or last stone set on top of wall or other project

D. Density — Closeness or arrangement of ingredients in stone; texture

E. Durable — Able to exist for a long period of time without significant deterioration

F. Fieldstone — Local stone found in the field and used as is

G. Limestone — Sedimentary rock consisting primarily of calcium carbonate in the form of calcite

H. Mortar set — Firmness or hardening of mortar

I. Plumb bob — Pointed weight hung from a line; used for vertical alignment when setting stone

J. Polygonal — Irregular shape with several straight edges

K. Quarrying — Process in which stone is removed from quarries (pit or open excavation)

L. Quartz — Rock-forming mineral consisting of silicon dioxide that occurs in crystalline masses

M. Rubble — Rough stone of irregular shape and size broken from larger masses by geological processes or by quarrying

N. Sandstone — Sedimentary rock consisting of quartz sand bonded by chemical cement

O. Wedge — Small piece of wood that tapers to a thin edge on one end

II. Reasons for using rough stone

A. Conforms to architectural design

B. Provides aesthetic value

INFORMATION SHEET

C. Is durable

D. Is available

E. Provides strength

F. Is preferred by customer

G. Performs well thermally

III. Types of rough stone

A. Sandstone

B. Limestone

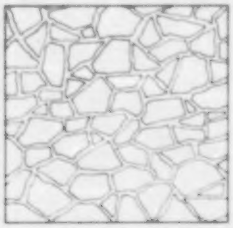
C. Granite

D. Fieldstone

IV. Types of rough-stone patterns (Figures 1-5)

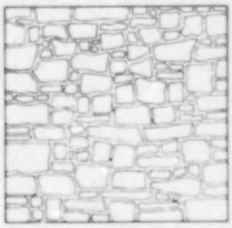
A. Uncoursed cobweb or polygonal rubble

FIGURE 1



B. Uncoursed and roughly squared

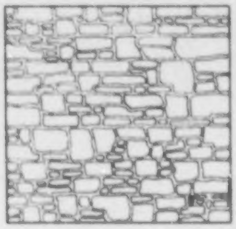
FIGURE 2



INFORMATION SHEET

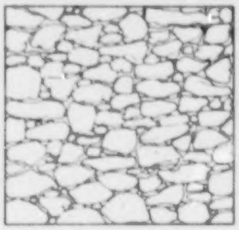
C. Coursed and roughly squared

FIGURE 3



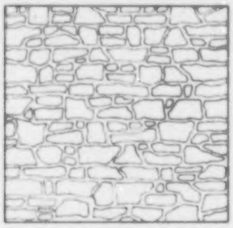
D. Uncoursed fieldstone, rough or common rubble

FIGURE 4



E. Coursed fieldstone, rough or common rubble

FIGURE 5



V. Procedures for setting rough stone

A. Determine location for wall

B. Clean area

C. Lay out wall

D. Spread mortar

INFORMATION SHEET

- E. Set stone
- F. Install ties and/or reinforcement as specified
- G. Check plumb and dimensions
- H. Finish joints as specified
- I. Clean stone
- J. Clean area around wall

VI. Methods used to protect stone during construction

(NOTE: Maintain all covering until it is finally removed.)

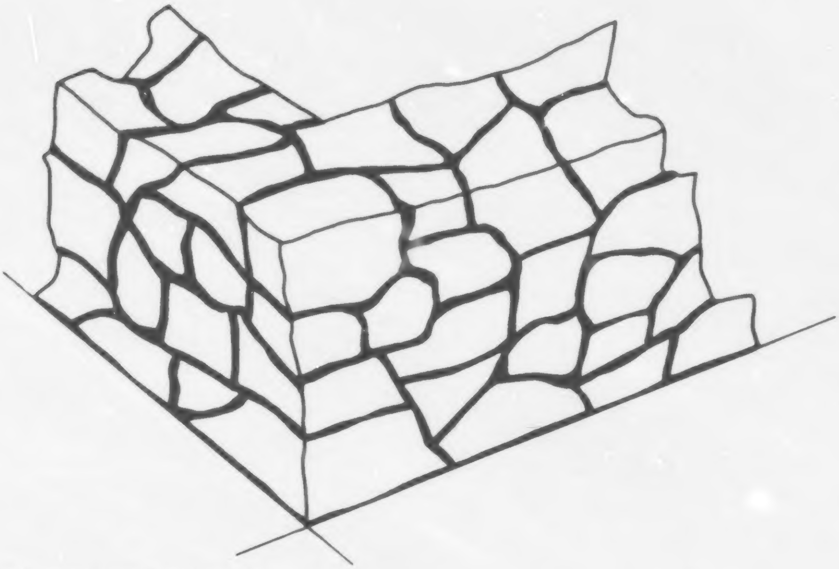
- A. Cover top of wall with building paper or membrane
- B. Cover walls against inclement weather with waterproof, nonstaining material
- C. Protect walls from droppings by covering with building paper or membrane, and then with substantial wood covering
- D. Cover all sills and copings with waterproof, nonstaining material, and then with substantial wood covering
- E. Where heavy traffic is prevalent, protect corners and edges with wood
- F. Build weatherproof enclosures to protect against bad weather and freezing

VII. Factors to consider when selecting type of stone and pattern to use

- A. Physical properties
- B. Availability
- C. Cost
- D. Appearance
- E. Location and orientation
- F. Durability
- G. Strength

ROUGH STONE
(RUBBLE)
UNIT II

JOB SHEET #1 — CONSTRUCT A STONE CORNER USING UNCOURSED COBWEB PATTERN



I. Equipment and materials

A. Brick trowel

B. Stone hammer

C. Brickmason's level

D. Mash hammer

E. Chisel

F. Jointer

G. Rake

H. Modular rule

I. Brush

J. Mortarboard and stand

K. Mortar box

JOB SHEET #1

- L. Hoe
- M. Square-point shovel
- N. Water bucket
- O. Water
- P. 1 ton of rough stones
- Q. Mortar
- R. Wall ties
- S. Chalk line
- T. Framing square
- U. Tape
- V. Specifications

  (NOTE: Instructor will furnish specifications.)

II. Procedure

- A. Lay out wall according to specifications
- B. Mix mortar
- C. Select a stone suitable for the cornerstone
- D. Spread bed-joint mortar for cornerstone
- E. Set stone, aligning it with both corner marks and keeping face plumb

  (NOTE: When setting rough stone, select each stone individually and cut or trim for proper fit. Use plumb bob to check corners for plumb and alignment.)

- F. Spread mortar and set second stone along one line

  (NOTE: Set stone on one side for about 4 feet before moving to opposite corner line.)

- G. Continue setting stone alternately from the corner out about 4 feet, keeping corner slightly higher and using wall ties as specified

  (NOTE: Wall ties are usually used about every 16 to 18 inches vertically and horizontally. As wall progresses, continue to maintain plumb, alignment, proper joint spacing, and correct dimensions.)

- H. When mortar becomes firm enough, tool or rake joints as specified

JOB SHEET #1

I. Continue setting stone until front side of wall is complete

(NOTE: Sometimes you must use small, water-soaked, wood wedges under stone to hold the stone in place. Remove wedges and patch holes after mortar sets.)

J. Move equipment and materials to opposite side of wall

K. Follow procedures in steps C through I to set stone on this side of wall

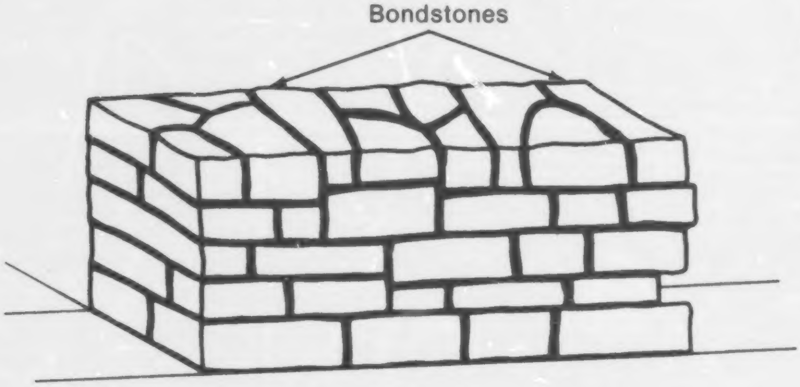
L. Clean excess mortar from stone when wall is completed

M. Clean area around wall

N. Clean and put away all equipment and materials

ROUGH STONE
(RUBBLE)
UNIT II

JOB SHEET #2 — LAY OUT AND CONSTRUCT A SECTION OF WALL USING COURSED RUBBLE WITH BONDSTONES



I. Equipment and materials

A. Tape

B. Framing square

C. Chalk line

D. Brick trowel

E. Stone hammer

F. Brickmason's level

G. Mash hammer

H. Chisel

I. Jointer

J. Rake

K. Modular rule

L. Brush

M. Mortarboard and stand

JOB SHEET #2

N. Mortar box

O. Hoe

P. Square-point shovel

Q. Water bucket

R. Water

S. 1 ton of rough stones

T. Mortar

U. Plumb bob

V. Specifications

(NOTE: Instructor will provide specifications.)

II. Procedure

A. Locate wall line and mark in two places about 8 feet apart

B. Snap a chalk line between the two marks

C. Measure over 18 inches from chalk line and make two marks

D. Snap a chalk line between these two marks, parallel with first chalk line

E. Locate end of wall and square across from one line to other

F. Mark this line

G. Mix mortar

H. Select a stone suitable for the cornerstone

I. Spread bed-joint mortar for cornerstone

J. Set stone, aligning it with both corner lines and maintaining a plumb face

(NOTE: Use plumb bob to check corners for plumb and alignment.)

K. Select second stone

(NOTE: Stone varies in size, density, and characteristics from one geographical area to another. Each stone has to be selected for the particular spot in which it will be set, and it may be necessary to cut or trim stone for a proper fit.)

JOB SHEET #2

L. Spread mortar for second stone

M. Set second stone, aligning face of stone with chalk line and keeping face plumb

N. Continue setting stone alternately from the corner out about 6 feet; keep corner slightly higher

(NOTE: As wall progresses, continue to maintain plumb, alignment, proper joint spacing, and correct dimensions.)

O. When mortar becomes firm enough, tool or rake joints as specified

(NOTE: Be sure to set bondstones every 2 feet or so.)

P. Continue setting stone to capstones

Q. Move equipment to opposite side of wall

R. Follow procedures in steps H through P to set stone on this side to capstones

S. Set capstones

T. Set a bondstone about every 2 feet

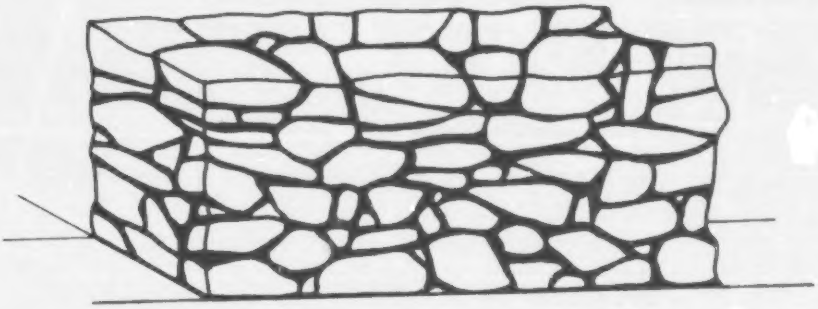
U. Clean excess mortar from stones when wall is complete

V. Clean surface around wall

W. Clean and put away all equipment and materials

ROUGH STONE
(RUBBLE)
UNIT II

JOB SHEET #3 — CONSTRUCT A SECTION OF WALL USING UNCOURSED FIELDSTONE



I. Equipment and materials

A. Brick trowel

B. Stone hammer

C. Brickmason's level

D. Mash hammer

E. Chisel

F. Jointer

G. Rake

H. Modular rule

I. Brush

J. Mortarboard and stand

K. Mortar box

L. Hoe

M. Square-point shovel

N. Water bucket

JOB SHEET #3

O. 1 ton of fieldstone

P. Mortar

Q. Wall ties

R. Plumb bob

S. Chalk line

T. Framing square

U. Tape

V. Specifications

(NOTE: Instructor will provide specifications.)

II. Procedure

A. Lay out wall according to specifications

B. Mix mortar

C. Select a stone suitable for the cornerstone

D. Spread bed-joint mortar for cornerstone

E. Set stone, aligning it with both corner lines and keeping face plumb

(NOTE: When setting rough stone, select each stone individually and cut or trim for a proper fit. Use plumb bob to check corners for plumb and alignment. Plumb face is maintained as close as possible since there is no way to set rough stone perfectly plumb.)

F. Spread mortar for next stone

G. Set next stone, keeping face plumb and in line with wall line

(NOTE: Set stone on one side of wall about half way up; then move to other side and bring stone up to that level.)

H. Continue setting stone alternately from the corner out about 4 feet, keeping corner slightly higher and using wall ties as specified

(NOTE: Wall ties are usually used about every 16 to 18 inches vertically and horizontally. As wall progresses, continue to maintain plumb, alignment, proper joint spacing, and correct dimensions.)

JOB SHEET #3

I. When mortar becomes firm enough, tool or rake joints as specified

J. Complete wall following specifications

(NOTE: Sometimes it is necessary to use small, water-soaked, wood wedges under stone to hold the stone in place. Remove wedges and patch holes after mortar sets.)

K. Smooth and level top of wall as best you can

L. Clean excess mortar from stones when wall is completed

M. Clean surface around wall

N. Clean and put away all equipment and materials

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ROUGH STONE
(RUBBLE)
UNIT II

TEST

NAME ______________________________ SCORE ______________

1. Match to their correct definitions terms associated with rough stone. Write the correct numbers in the blanks.

_____a. Sedimentary rock consisting of quartz sand bonded by chemical cement

_____b. Relating to or dealing with beautiful or artistic works

_____c. Sedimentary rock consisting primarily of calcium carbonate in the form of calcite

_____d. Irregular shape with several straight edges

_____e. Local stone found in the field and used as is

_____f. Able to exist for a long period of time without significant deterioration

_____g. Rock-forming mineral consisting of silicon dioxide that occurs in crystalline masses

_____h. Process in which stone is removed from quarries (pit or open excavation)

_____i. Rough stone of irregular shape and size broken from larger masses by geological processes or by quarrying

_____j. Firmness or hardening of mortar

_____k. Top or last stone set on top of wall or other project

_____l. Small piece of wood that tapers to a thin edge on one end

_____m. Stone that extends completely through wall to tie (bond) both sides together

_____n. Closeness or arrangement of ingredients in stone; texture

_____o. Pointed weight hung from a line; used for vertical alignment when setting stone

1. Polygonal
2. Quarrying
3. Sandstone
4. Durable
5. Rubble
6. Aesthetic
7. Limestone
8. Quartz
9. Fieldstone
10. Density
11. Wedge
12. Mortar set
13. Bondstone
14. Capstone
15. Plumb bob

TEST

2. Select from the following list reasons for using rough stone. Write an "X" in the blank before each correct answer.

_____a. Provides aesthetic value

_____b. Is easy to set

_____c. Is cheap

_____d. Is durable

_____e. Is available

_____f. Is preferred by customer

_____g. Is waterproof

_____h. Provides strength

_____i. Conforms to architectural design

_____j. Performs well thermally

3. Name three types of rough stone.

a. ____

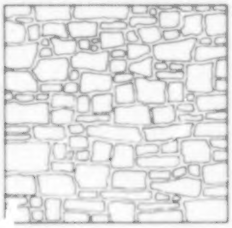
b. ____

c. ____

TEST

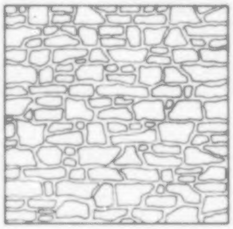
4. Identify the following types of rough-stone patterns. Write the correct names in the blanks.

Uncoursed and roughly squared
Uncoursed cobweb or polygonal rubble
Uncoursed fieldstone, rough or common rubble
Coursed fieldstone, rough or common rubble
Coursed and roughly squared



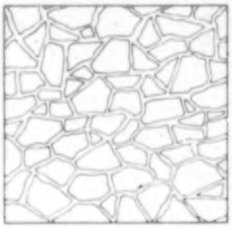
a. ______________________________

____



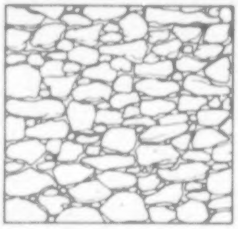
b. ______________________________

____



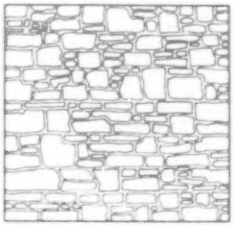
c. ______________________________

____



d. ______________________________

____



e. ______________________________

____

TEST

5. Arrange in order procedures for setting rough stone. Write a "1" in the blank before the first procedure, a "2" in the blank before the second procedure, and so on.

_____a. Set stone

_____b. Check plumb and dimensions

_____c. Clean area

_____d. Finish joints as specified

_____e. Determine location for wall

_____f. Spread mortar

_____g. Clean area around wall

_____h. Install ties and/or reinforcement as specified

_____i. Lay out wall

_____j. Clean stone

6. State three methods used to protect stone during construction.

a. ____

____

b. ____

____

c. ____

____

7. State four factors to consider when selecting type of stone and pattern to use.

a. ____

b. ____

c. ____

d. ____

TEST

(NOTE: Test question 8 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

8. Demonstrate the ability to

   a. Construct a stone corner using uncoursed cobweb pattern.

   b. Lay out and construct a section of wall using coursed rubble with bondstones.

   c. Construct a section of wall using uncoursed fieldstone.

ROUGH STONE
(RUBBLE)
UNIT II

ANSWERS TO TEST

1.

a.	3	i.	5
b.	6	j.	12
c.	7	k.	14
d.	1	l.	11
e.	9	m.	13
f.	4	n.	10
g.	8	o.	15
h.	2		

2. a, d, e, f, h, i, j

3. Answer should include any three of the following
   a. Sandstone
   b. Limestone
   c. Granite
   d. Fieldstone

4. a. Uncoursed and roughly squared
   b. Coursed fieldstone, rough or common rubble
   c. Uncoursed cobweb or polygonal rubble
   d. Uncoursed fieldstone, rough or common rubble
   e. Coursed and roughly squared

ANSWERS TO TEST

5. a. 5
   b. 7
   c. 2
   d. 8
   e. 1
   f. 4
   g. 10
   h. 6
   i. 3
   j. 9

6. Answer should include any three of the following
   a. Cover top of wall with building paper or membrane
   b. Cover walls against inclement weather with waterproof, nonstaining material
   c. Protect walls from droppings by covering with building paper or membrane, and then with substantial wood covering
   d. Cover all sills and copings with waterproof, nonstaining material, and then with substantial wood covering
   e. Where heavy traffic is prevalent, protect corners and edges with wood
   f. Build weatherproof enclosures to protect against bad weather and freezing

7. Answer should include any four of the following
   a. Physical properties
   b. Availability
   c. Cost
   d. Appearance
   e. Location and orientation
   f. Durability
   g. Strength

8. Performance skills evaluated to the satisfaction of the instructor

PRECAST AND PREFAB UNITS
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to determine whether or not to use precast and prefab units, and should be able to set precast and prefab panels. The student should also be able to identify types of anchors and supports. The student will show this knowledge by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with precast and prefab units to their correct definitions.
2. List types of precast and prefab units.
3. State factors to consider before using precast or prefab units.
4. Select from a list reasons for using precast or prefab panels.
5. Identify types of anchors and supports used to set precast or prefab panels.
6. Label accessories and devices used to handle precast or prefab panels.
7. Label types of equipment used to set precast and prefab units.
8. Arrange in order the procedures for erecting precast and prefab panels.
9. Demonstrate the ability to
    a. Set and anchor a precast or prefab panel.
    b. Construct a precast or prefab panel wall with raked joints.

PRECAST AND PREFAB UNITS
UNIT I

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Provide students with objective sheet.

   B. Discuss unit and specific objectives.

   C. Provide students with information and job sheets.

   D. Discuss information sheet.

   E. Take students on field trip to see panels being set.

   F. Provide a variety of anchors and supports for students so that students may become familiar with them.

   G. Provide equipment and materials needed to complete job sheets.

   H. Provide students with necessary techniques, hints, and job skills that are essential when setting precast or prefab panels.

   I. Have students refer to the rigging unit, "Miscellaneous Equipment," in *Principles of Bricklaying* before trying to rig and hoist precast or prefab panels.

   J. Have students practice rigging panels before trying to set precast or prefab panels.

   K. Provide students with shop drawings and specifications for job sheets.

   L. Give test.

   M. Complete appropriate section of competency profiles.

   (NOTE: Competency profiles are available from AGC and CIMC.)

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

SUGGESTED ACTIVITIES

D. Job sheets

   1. Job Sheet #1 — Set and Anchor a Precast or Prefab Panel

   2. Job Sheet #2 — Construct a Precast or Prefab Panel Wall with Raked Joints

E. Test

F. Answers to test

III. Unit references

A. Hendrix, Laborn J., "Bud." *Construction Craftsman's Curriculum.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1978.

B. Hendrix, Laborn J., "Bud." *Heavy Equipment Operator: General Equipment Operator.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1982.

C. Hendrix, Laborn J., "Bud." *Millwright Instructional Materials.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1978.

D. Ramsey, Charles G., and Harold R. Sleeper. *Architectural Graphic Standards*, 6th ed. New York: John Wiley and Sons, Inc., 1970.

E. Turcotte, Raymond J. *Bricklaying Curriculum.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1977.

PRECAST AND PREFAB UNITS
UNIT I

INFORMATION SHEET

I. Terms and definitions

- A. Precast unit — Unit prepared at job site or plant, moved, and erected at final position
- B. Prefab unit — Unit constructed at a plant and delivered ready to be erected at job site
- C. Anchor — Metal device used to secure panel in place and to secure panels to each other
- D. Support — Steel angle or plate secured to the building; designed for easing panel erection and maintaining adequate panel support
- E. Tilt-up panel — Concrete panel constructed on job site, then tilted up into final position
- F. Durability — Ability to resist weathering action, chemical attack, abrasion, and other conditions of service
- G. Tolerance — Acceptable variation from a standard size
- H. Spall — Small fragment or chip broken from panel
- I. Repairing panel — Patching places that may have spalled during moving and setting procedures

II. Types of precast and prefab units

- A. Precast concrete panel
- B. Prefab concrete panel
- C. Prefab brick panel
- D. Prefab stone panel
- E. Prefab marble panel
- F. Prefab exposed-aggregate panel
- G. Prefab ceramic panel
- H. Precast concrete slab

INFORMATION SHEET

  I. Precast concrete tee
  J. Precast concrete plank
  K. Precast steps
  L. Precast barrier and parapet wall
  M. Prefab tilt-up panel

III. Factors to consider before using precast or prefab units

  A. Initial cost
  B. Strength
  C. Durability
  D. Physical properties
  E. Performance characteristics
  F. Architectural design
  G. Aesthetic value
  H. Erection time
  I. Maintenance
  J. Fabrication and storage
  K. Type and availability of hoisting equipment

IV. Reasons for using precast or prefab panels

  A. Can be erected quickly
  B. Can be installed in almost any weather
  C. Are economical
  D. Are fire-resistant
  E. Are strong
  F. Are durable
  G. Require minimum maintenance

INFORMATION SHEET

H. Provide aesthetic value

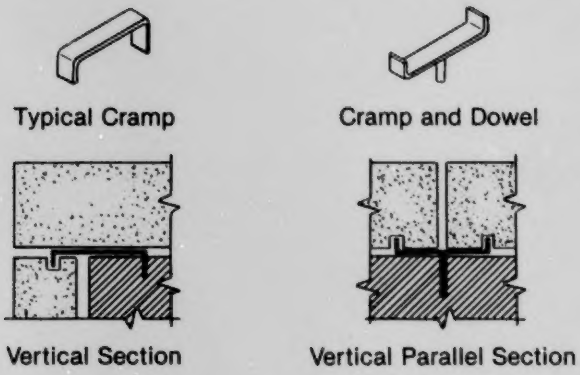
I. May be preferred by customer

V. Types of anchors and supports used to set precast or prefab panels (Figures 1-16)

(NOTE: Architects increasingly specify custom-designed anchors; therefore, stonemasons should be familiar with these anchors.)

A. Joint anchoring with cramp anchors

FIGURE 1



Typical Cramp

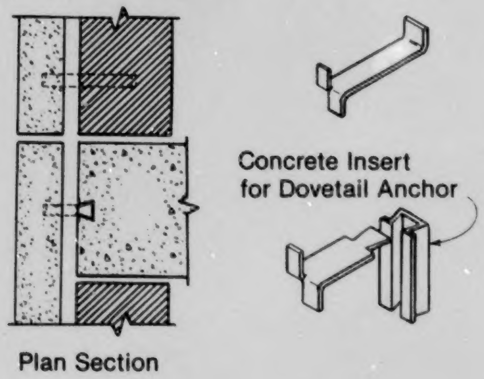
Cramp and Dowel

Vertical Section

Vertical Parallel Section

B. Panels anchored to backup with two-way anchor and dovetail anchor

FIGURE 2



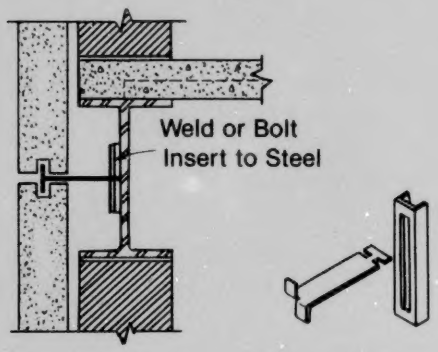
Plan Section

Figures 1 through 16 from *Architectural Grapihic Standards*, 6th ed., by Charles G. Ramsey and Harold R. Sleeper. Copyright ©1970, John Wiley and Sons, Inc. Reprinted by permission of John Wiley and Sons, Inc.

INFORMATION SHEET

C. Facing anchored to spandrel beam with channel insert and two-way anchor

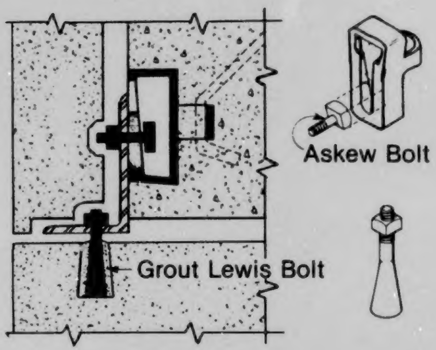
FIGURE 3


Weld or Bolt
Insert to Steel

Vertical Section

D. Concrete insert, relief angle, and lewis bolt hung from concrete beam

FIGURE 4

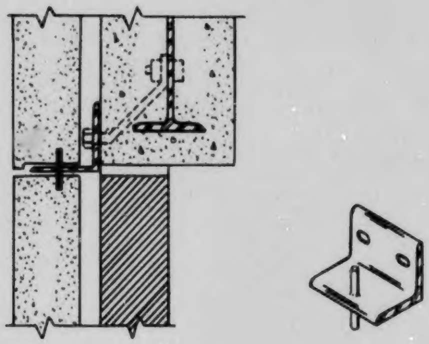

Askew Bolt
Grout Lewis Bolt

Vertical Section

INFORMATION SHEET

E. Angle and dowel at spandrel, using bolt back to steel beam

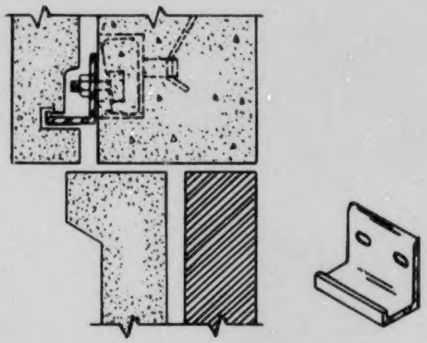
FIGURE 5



Vertical Section

F. Insert and angle anchor showing concealed support

FIGURE 6

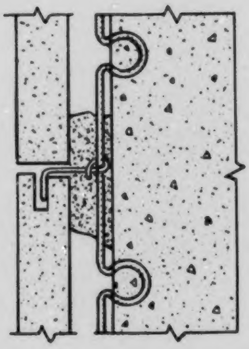


Vertical Section

INFORMATION SHEET

G. Adjustable wire insert cast into concrete

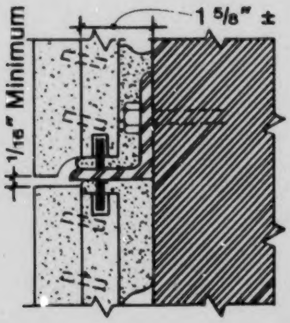
FIGURE 7



Vertical Section

H. Typical relief joint, using strip liners and dowels

FIGURE 8

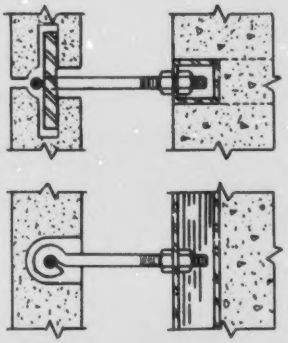


Vertical Section

INFORMATION SHEET

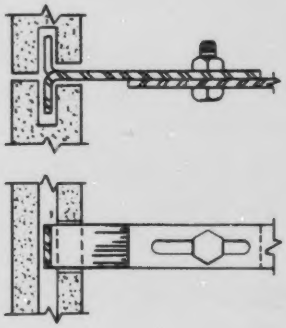
I. Eyebolt and dowel bolted to slotted concrete insert

FIGURE 9



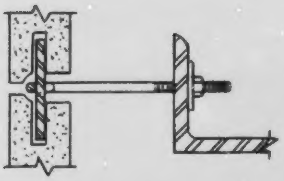
J. Two-way strap hanger with slotted adjustment

FIGURE 10



K. Eyebolt and dowel anchored to steel

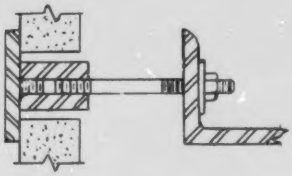
FIGURE 11



INFORMATION SHEET

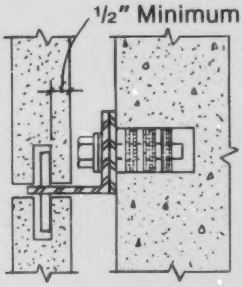
L. Threaded rosette anchored to steel

FIGURE 12



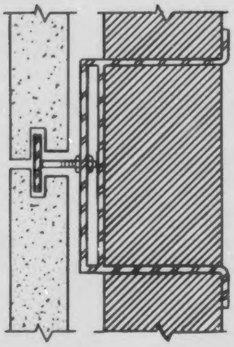
M. Strap and pin with cinch anchor

FIGURE 13



N. Slotted insert laid in unit backup with threaded insert bolt

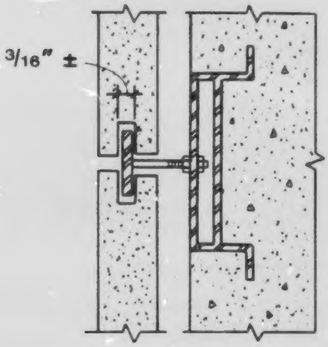
FIGURE 14



INFORMATION SHEET

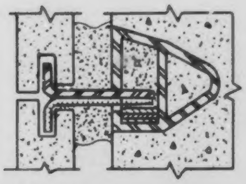
O. Slotted concrete insert with threaded insert bolt

FIGURE 15

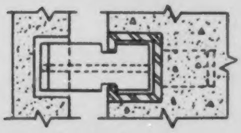


P. Concrete insert with strap and wire tieback and metal shims

FIGURE 16



Section



Plan

INFORMATION SHEET

VI. Accessories and devices used to handle precast or prefab panels (Figure 17-24)

A. Bridles

FIGURE 17

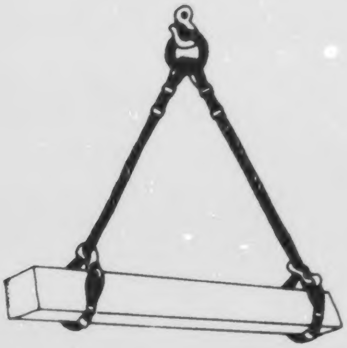
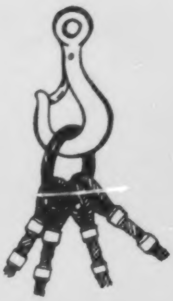


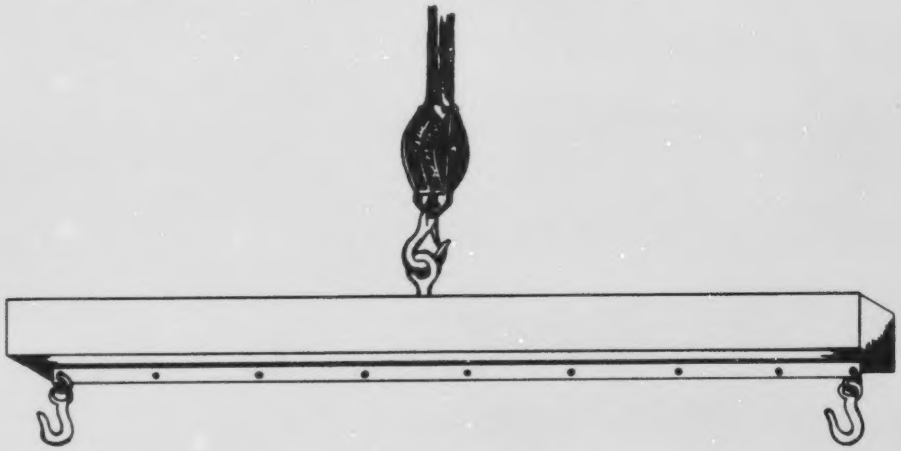
FIGURE 18



B. Spreader bars

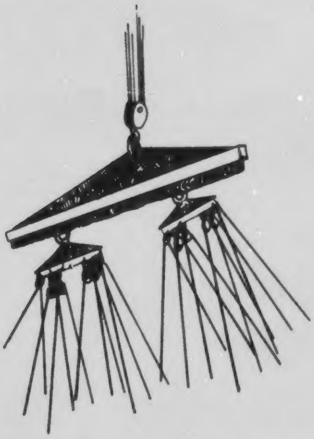
FIGURE 19

FIGURE 20



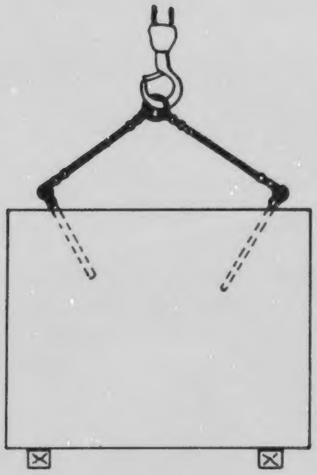
INFORMATION SHEET

FIGURE 21



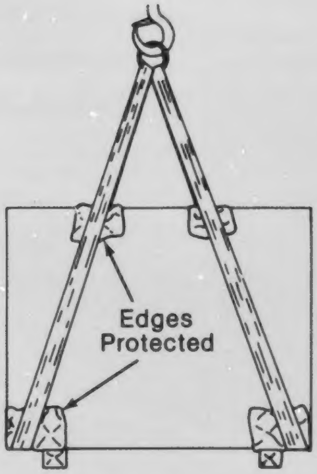
C. Lewis pins and bridle

FIGURE 22



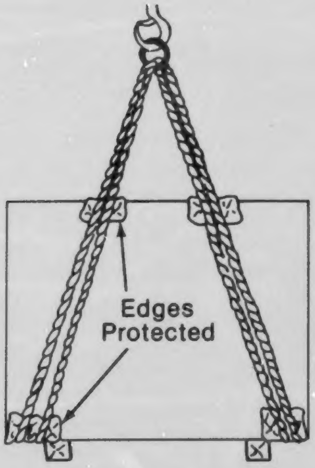
D. Straps

FIGURE 23


Edges
Protected

E. Chokers or slings

FIGURE 24

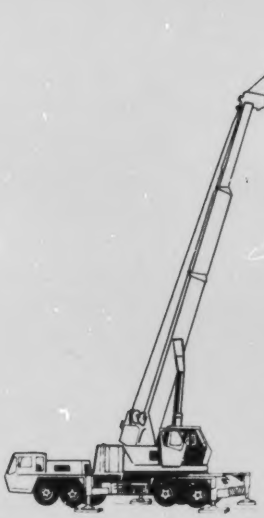

Edges
Protected

INFORMATION SHEET

VII. Types of equipment used to set precast and prefab units (Figures 25-30)

A. Mobile crane

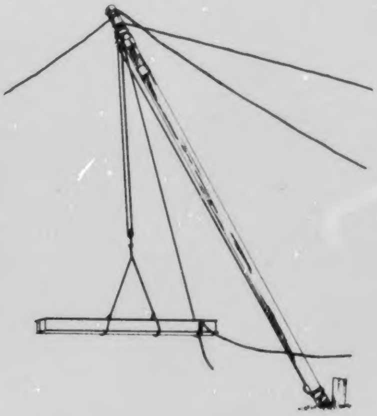
FIGURE 25



With permission of the Construction Safety Association of Ontario.

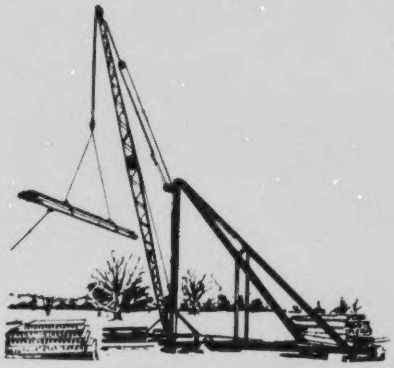
B. Gin pole

FIGURE 26



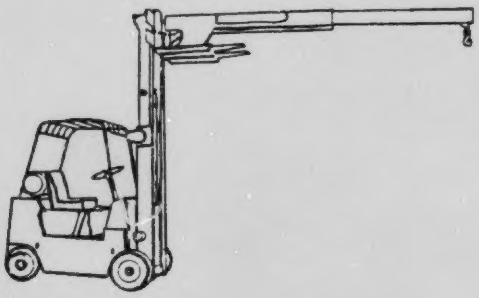
C. Stiffleg derrick

FIGURE 27



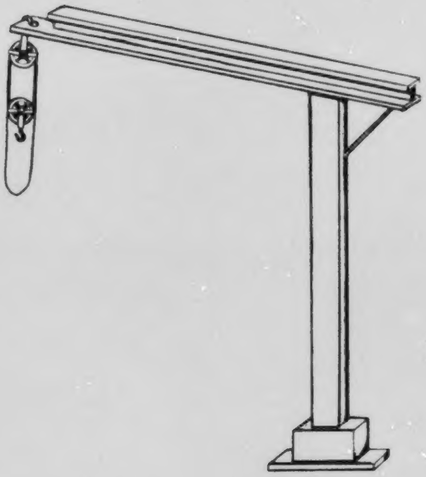
D. Forklift

FIGURE 28



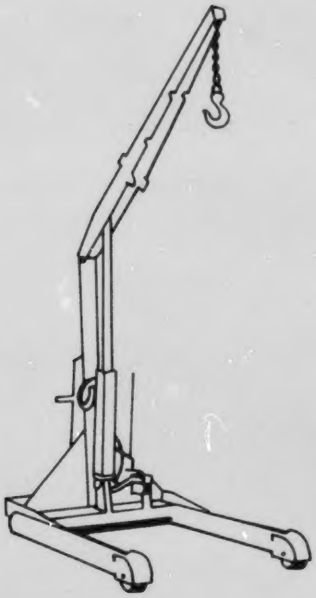
E. Jib crane

FIGURE 29



F. Floor crane

FIGURE 30



VIII. Procedures for erecting precast and prefab panels

(NOTE: Set panels in strict accordance with contract and shop drawings.)

A. Check drawings for panel identification

B. Check tolerance of building frame and panel erection

C. Check joint size and treatment

D. Coordinate erection with other trades

E. Spot hoisting equipment

F. Clean and prepare panels for erection

G. Hoist panels

H. Set panels

INFORMATION SHEET

I. Anchor panels

J. Align, plumb, and level panels

K. Disconnect hoist

L. Maintain proper joints

M. Treat joints

(NOTE: Some joints such as tongue-and-groove and overlapping joints are treated with caulking or sealant during erection procedures.)

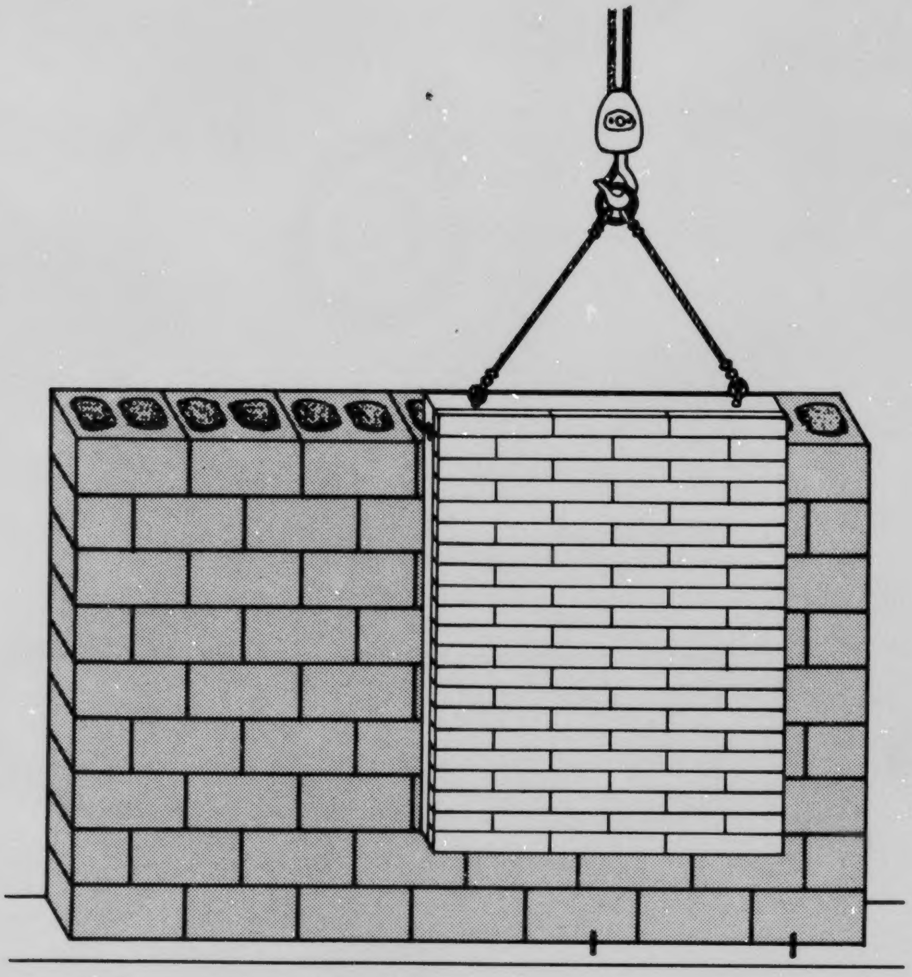
N. Clean panels

O. Repair where needed

(NOTE: Repairing panels is an accepted practice, providing it is done according to industry standards.)

PRECAST AND PREFAB UNITS
UNIT I

JOB SHEET #1 — SET AND ANCHOR A PRECAST OR PREFAB PANEL



I. Equipment and materials

  A. Brick trowel

  B. Stonemason's hammer

JOB SHEET #1

- C. Chisel
- D. Bricklayer's level
- E. Lewis pins and bridle
- F. Lifting equipment
- G. Rule or tape
- H. Mortarboard and stand
- I. Mortar box, hoe, and shovel
- J. Water bucket
- K. Nonstaining mortar
- L. Panel
- M. Anchors as specified
- N. Wood wedges
- O. Shop drawings and specifications

  (NOTE: Shop drawings and specifications will be furnished by the instructor.)

II. Procedure

- A. Check shop drawings and specifications for joint size and treatment
- B. Spot hoisting equipment
- C. Mix mortar
- D. Rig panel for hoisting
- E. Clean and prepare panel for setting
- F. Hoist panel and move into position
- G. Apply full bed of mortar to bed joint
- H. Align holes in panel with dowel rods while panel is being lowered

JOB SHEET #1

I. Continue lowering panel to its proper position

(NOTE: You may need to use water-soaked wood wedges to keep panel from squeezing mortar out of the joint.)

J. Maintain proper mortar joint

K. Install and attach anchors as specified

L. Disconnect lifting device

M. Align, plumb, and level panel

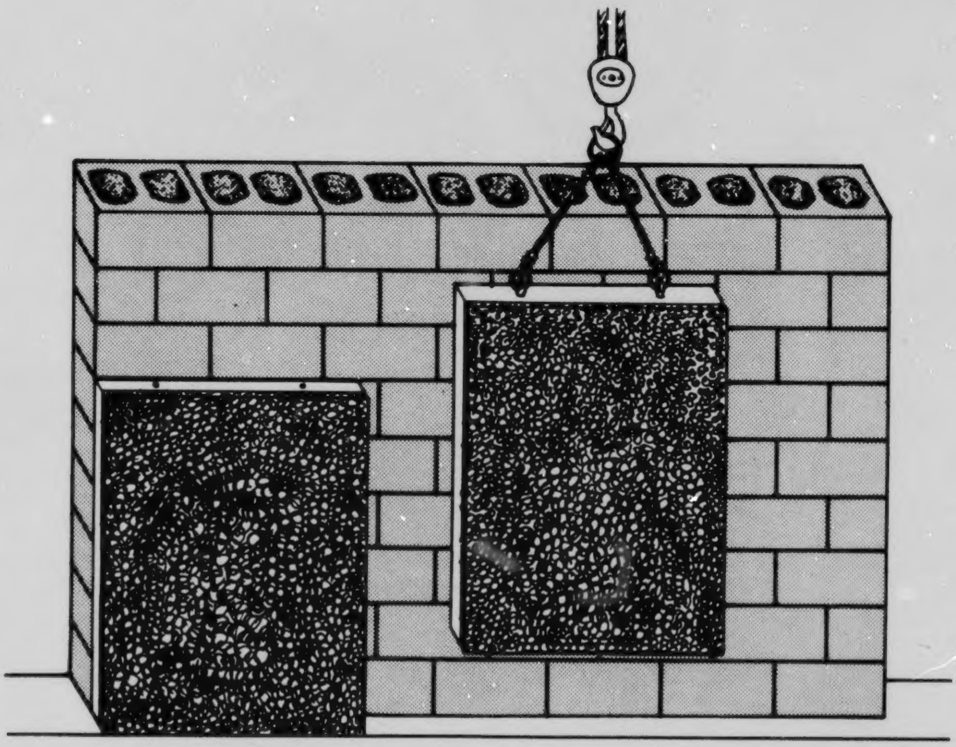
N. Clean panel

O. Clean area around wall

P. Clean and put away all equipment and materials

PRECAST AND PREFAB UNITS
UNIT I

JOB SHEET #2 — CONSTRUCT A PRECAST OR PREFAB PANEL WALL WITH RAKED JOINTS



I. Equipment and materials

   A. Shop drawings and specifications

      (NOTE: Shop drawings and specifications will be furnished by the instructor.)

   B. Brick trowel

   C. Stonemason's hammer

   D. Chisel

   E. Bricklayer's level

   F. Lewis pins and bridle

   G. Lifting equipment

JOB SHEET #2

H. Rule or tape

I. Wood wedges

J. Mortarboard and stand

K. Mortar box, hoe, and shovel

L. Water bucket

M. Nonstaining mortar

N. Panels

O. Anchors as specified

P. Joint rake

II. Procedure

A. Check shop drawings to confirm number of first panel

B. Check panel and select one with number corresponding with drawings

(NOTE: Drawings will show number and location of each panel, and each panel will be marked with a corresponding number.)

C. Check specifications for joint size and treatment

D. Spot hoisting equipment

E. Mix mortar

F. Rig panel for hoisting

G. Clean and prepare panel for setting

H. Hoist panel and move it into position

I. Apply full bed of mortar to bed joint

J. Align panel as it is being lowered

K. Continue to lower panel to its proper position

(NOTE: You may need to use water-soaked wood wedges to keep panel from squeezing mortar out of the joint.)

L. Maintain proper mortar joint

JOB SHEET #2

M. Install and attach anchors as specified

N. Disconnect lifting device

O. Align, plumb, and level first panel

P. Clean panel

Q. Select panel number two

R. Rig panel for hoisting

S. Continue to follow procedures F through P to set panel number two and remaining panels

T. Tuck-point all vertical joints

U. Rake out all other joints

V. Clean wall

W. Clean area around wall

X. Clean and put away all equipment and materials

ABL - 29-C

PRECAST AND PREFAB UNITS
UNIT I

TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with precast and prefab units to their correct definitions. Write the correct numbers in the blanks.

_____a. Unit constructed at a plant and delivered ready to be erected at job site

_____b. Steel angle or plate secured to the building; designed for easing panel erection and maintaining adequate panel support

_____c. Ability to resist weathering action, chemical attack, abrasion, and other conditions of service

_____d. Patching places that may have spalled during moving and setting procedures

_____e. Small fragment or chip broken from panel

_____f. Acceptable variation from a standard size

_____g. Concrete panel constructed on job site, then tilted up into final position

_____h. Unit prepared at job site or plant, moved, and erected at final position

_____i. Metal device used to secure panel in place and to secure panels to each other

1. Repairing panel
2. Support
3. Tolerance
4. Precast unit
5. Spall
6. Prefab unit
7. Tilt-up panel
8. Anchor
9. Durability

2. List six types of precast and prefab units.

a. ______________________________

b. ______________________________

c. ______________________________

TEST

d. ______________________________

e. ______________________________

f. ______________________________

3. State six factors to consider before using precast or prefab units.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

4. Select from the following list reasons for using precast or prefab panels. Write an "X" in the blank before each correct answer.

_____a. Are durable

_____b. Are lightweight

_____c. Require minimum maintenance

_____d. Are economical

_____e. Are strong

_____f. Are fire-resistant

_____g. Are easy for one person to handle

_____h. Can be installed in almost any weather

_____i. Are abrasive resistant

_____j. Provide aesthetic value

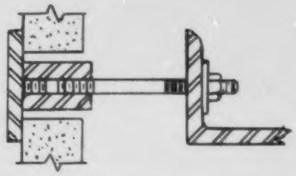
_____k. May be preferred by customer

_____l. Can be erected quickly

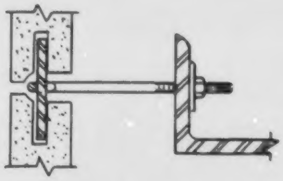
TEST

5. Identify the following types of anchors and supports used to set precast or prefab panels. Write the correct names in the blanks.

Joint anchoring with cramp anchors
Facing anchored to spandrel beam with channel insert and two-way anchor
Panels anchored to backup with two-way anchor and dovetail anchor
Concrete insert, relief angle, and lewis bolt hung from concrete beam
Angle and dowel at spandrel, using bolt back to steel beam
Strap and pin with cinch anchor
Insert and angle anchor showing concealed support
Adjustable wire insert cast into concrete
Typical relief joint, using strip liners and dowels
Eyebolt and dowel bolted to slotted concrete insert
Two-way strap hanger with slotted adjustment
Eyebolt and dowel anchored to steel
Slotted insert laid in unit backup with threaded insert bolt
Slotted concrete insert with threaded insert bolt
Threaded rosette anchored to steel
Concrete insert with strap and wire tieback and metal shims

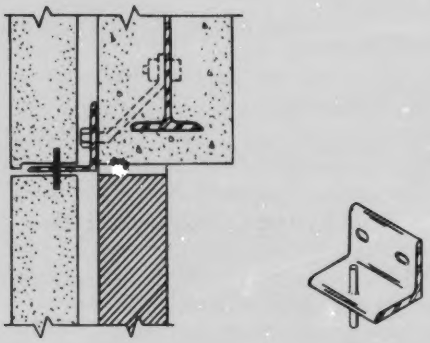


a. ____

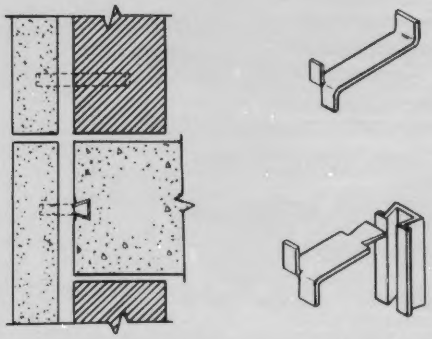


b. ____

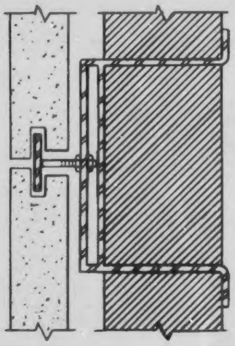
TEST



c. ____________________

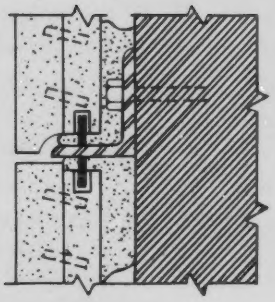


d. ____________________

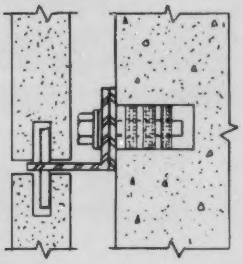


e. ____________________

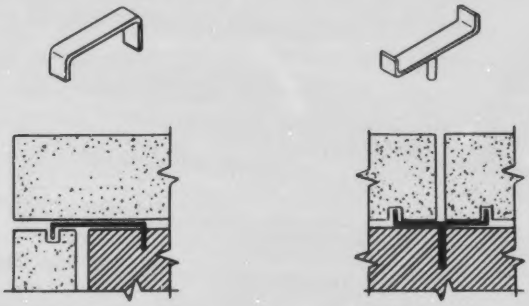
TEST



f. ______________________________



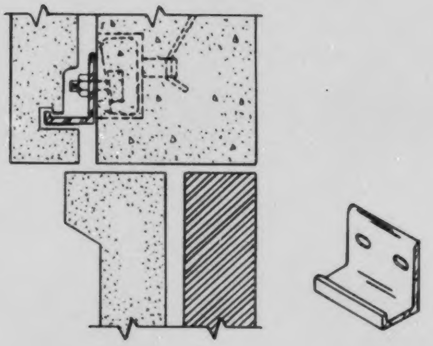
g. ______________________________



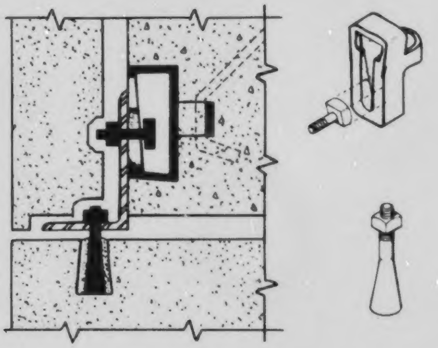
h. ______________________________

34-C

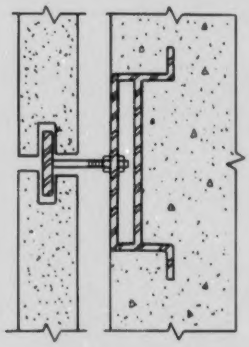
TEST



i. ______________________________

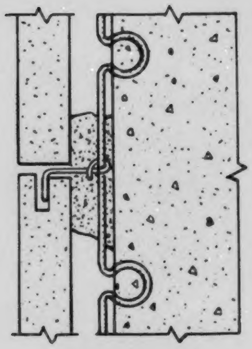


j. ______________________________

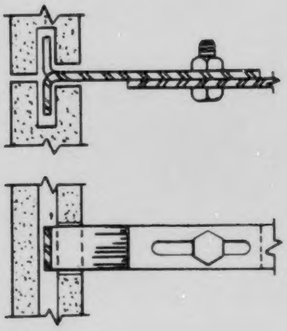


k. ______________________________

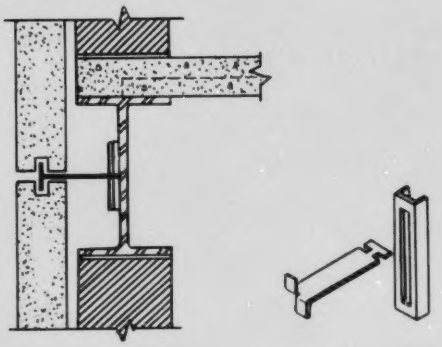
TEST



l. ______________________________

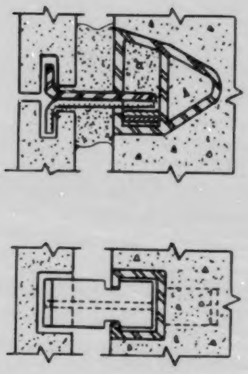


m. ______________________________

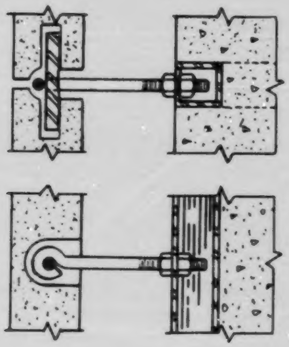


n. ______________________________

TEST

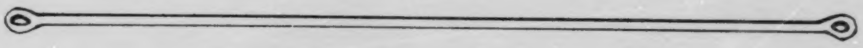


o. ______________________________



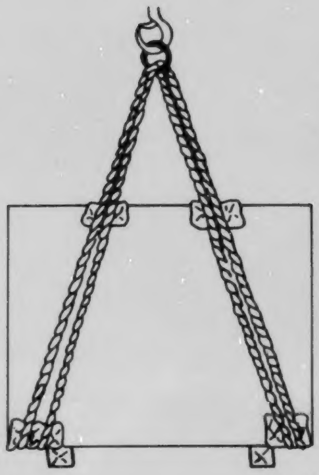
p. ______________________________

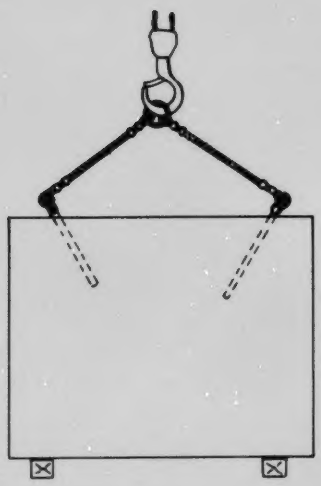
6. Label the following accessories and devices used to handle precast or prefab panels. Write the correct names in the blanks.



a. ______________________________

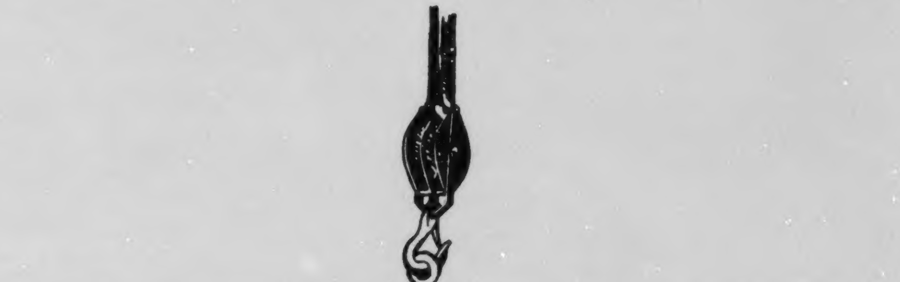
TEST





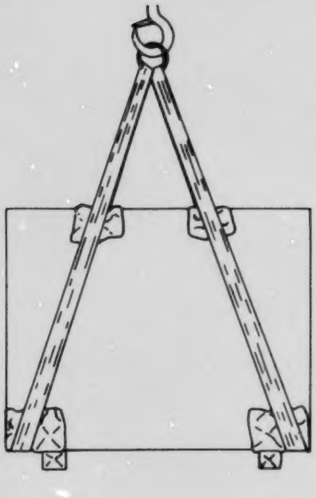
b. ______________________________

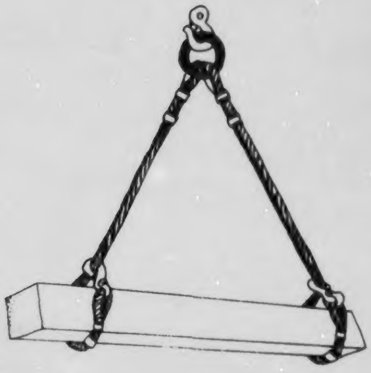
c. ______________________________



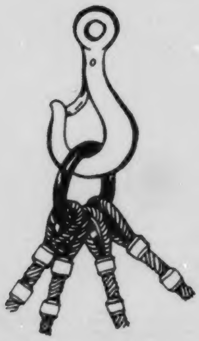
d. ______________________________

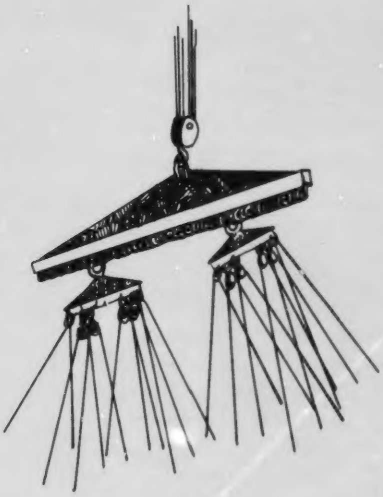
TEST





e. ______________________________ f. ______________________________

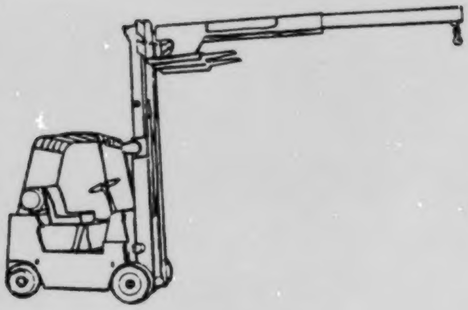




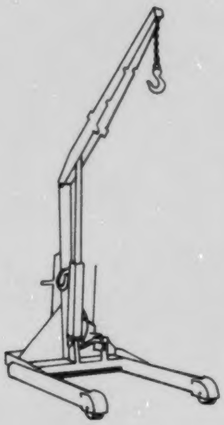
g. ______________________________ h. ______________________________

TEST

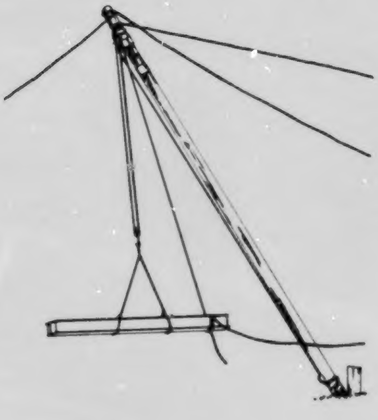
7. Label the following types of equipment used to set precast and prefab units. Write the correct names in the blanks.



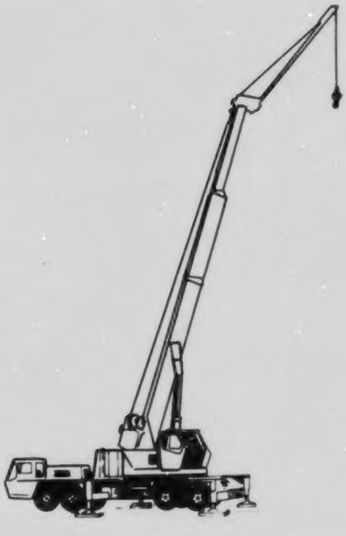
a. ______________________



b. ______________________

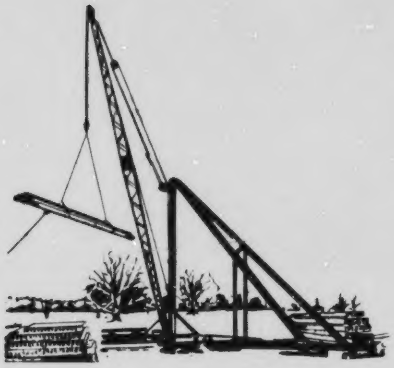


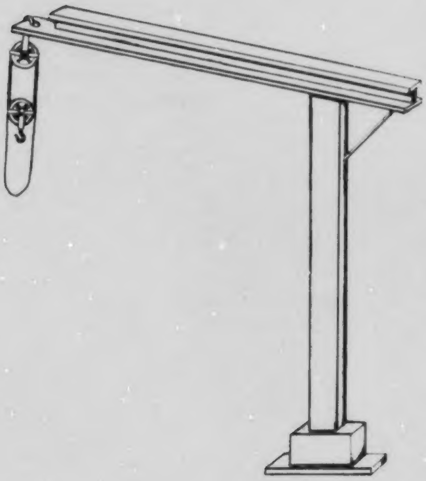
c. ______________________



d. ______________________

TEST





e. ______________________________ f. ______________________________

8. Arrange in order the procedures for erecting precast and prefab panels. Write a "1" in the blank for the first procedure, a "2" in the blank for the second procedure, and so on. Procedures continue on the following page.

_____a. Hoist panels

_____b. Coordinate erection with other trades

_____c. Clean panels

_____d. Align, plumb, and level panels

_____e. Check tolerance of building frame and panel erection

_____f. Clean and prepare panels for erection

_____g. Disconnect hoist

_____h. Check joint size and treatment

_____i. Treat joints

TEST

_____j. Set panels

_____k. Check drawings for panel identification

_____l. Repair where needed

_____m. Anchor panels

_____n. Spot hoisting equipment

_____o. Maintain proper joints

(NOTE: Test question 9 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

9. Demonstrate the ability to

   a. Set and anchor a precast or prefab panel.

   b. Construct a precast or prefab panel wall with raked joints.

PRECAST AND PREFAB UNITS
UNIT I

ANSWERS TO TEST

1.
    a. 6
    b. 2
    c. 9
    d. 1
    e. 5
    f. 3
    g. 7
    h. 4
    i. 8

2. Answer should include any six of the following
    a. Precast concrete panel
    b. Prefab concrete panel
    c. Prefab brick panel
    d. Prefab stone panel
    e. Prefab marble panel
    f. Prefab exposed-aggregate panel
    g. Prefab ceramic panel
    h. Precast concrete slab
    i. Precast concrete tee
    j. Precast concrete plank
    k. Precast steps
    l. Precast barrier and parapet wall
    m. Prefab tilt-up panel

3. Answer should include any six of the following
    a. Initial cost
    b. Strength

ANSWERS TO TEST

- c. Durability
- d. Physical properties
- e. Performance characteristics
- f. Architectural design
- g. Aesthetic value
- h. Erection time
- i. Maintenance
- j. Fabrication and storage
- k. Type and availability of hoisting equipment

4. a, c, d, e, f, h, j, k, l

5. a. Threaded rosette anchored to steel
   b. Eyebolt and dowel anchored to steel
   c. Angle and dowel at spandrel, using bolt back to steel beam
   d. Panels anchored to backup with two-way anchor and dovetail anchor
   e. Slotted insert laid in unit backup with threaded insert bolt
   f. Typical relief joint, using strip liners and dowels
   g. Strap and pin with cinch anchor
   h. Joint anchoring with cramp anchors
   i. Insert and angle anchor showing concealed support
   j. Concrete insert, relief angle, and lewis bolt hung from concrete beam
   k. Slotted concrete insert with threaded insert bolt
   l. Adjustable wire insert cast into concrete
   m. Two-way strap hanger with slotted adjustment
   n. Facing anchored to spandrel beam with channel insert and two-way anchor

ANSWERS TO TEST

o. Concrete insert with strap and wire tieback and metal shims

p. Eyebolt and dowel bolted to slotted concrete insert

6. a. Spreader bar

b. Chokers or slings

c. Lewis pins and bridle

d. Spreader bar

e. Straps

f. Bridle

g. Bridle

h. Spreader bar

7. a. Forklift

b. Floor crane

c. Gin pole

d. Mobile crane

e. Stiffleg derrick

f. Jib crane

8.

a.	7	f.	6	k.	1
b.	4	g.	11	l.	15
c.	14	h.	3	m.	9
d.	10	i.	13	n.	5
e.	2	j.	8	o.	12

9. Performance skills evaluated to the satisfaction of the instructor

STONE, SLATE, MARBLE, AND GRANITE PANELS
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to identify types of stone anchors and supports and construct stone panel walls. The student will show this knowledge by completing the job sheet and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with stone, slate, marble, and granite panels.
2. Select from a list reasons for using panels.
3. State physical properties of stone, slate, marble, and granite panels.
4. List types of finishes used on stone, slate, marble, and granite panels.
5. Identify types of anchors used to set panels.
6. Identify types of support systems used on panels.
7. Label devices used to handle panels.
8. Label types of equipment used to set panels.
9. State guidelines for setting stone, slate, marble, and granite panels.
10. Match temperatures to the correct protection requirements for cold-weather construction.
11. State qualities of mortar in finished walls.
12. State factors to consider prior to using stone, slate, marble, or granite panels.
13. Demonstrate the ability to construct a stone wall, using stone panels with raked joints.

STONE, SLATE, MARBLE, AND GRANITE PANELS
UNIT II

SUGGESTED ACTIVITIES

I. Suggested activities

A. Order filmstrips to supplement unit.

1. *Designing with Indiana Limestone.* Available from Indiana Limestone Institute of America, Inc., Stone City Bank Building, Suite 400, Bedford, Indiana 47421.

2. *Contemporary Architecture and Indiana Limestone.* Available from Indiana Limestone Institute of America, Inc., Stone City Bank Building, Suite 400, Bedford, Indiana 47421.

B. Provide students with objective sheet.

C. Discuss unit and specific objectives.

D. Provide students with information and job sheets.

E. Discuss information sheet.

F. Take students on field trip to observe panels being set.

G. Show students different types of anchors and supports.

H. Provide students with techniques, hints, and job skills essential to setting stone, slate, marble, and granite and becoming an accomplished stone setter.

I. Demonstrate and discuss procedures outlined in the job sheet.

J. Provide equipment and materials necessary to accomplish procedures outlined in job sheet.

K. Provide students with specifications for job sheet.

L. Have students refer to the rigging section in *Principles of Bricklaying,* Section A, Unit III, "Miscellaneous Equipment," before trying to rig or hoist panels.

M. Give test.

N. Complete appropriate section of competency profiles.

(NOTE: Competency profiles are available from AGC and CIMC.)

SUGGESTED ACTIVITIES

II. Instructional materials

- A. Objective sheet
- B. Suggested activities
- C. Information sheet
- D. Job Sheet #1 — Construct a Stone Wall, Using Stone Panels with Raked Joints
- E. Test
- F. Answers to test

III. Unit references

A. "Briar Hill Pamphlet." Glenmont, Ohio: Briar Hill Stone Company, n.d.

B. Graham, Frank D., and Thomas J. Emery. *Audel's Mason's and Builder's Guide No. 4.* New York: Theo Audel and Company Publishers, 1943.

C. Hendrix, Laborn J., "Bud." *Heavy Equipment Operator: General Equipment Operator.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and Associated General Contractors of America, 1982.

D. *Indiana Limestone Handbook.* Bedford, Indiana: Indiana Limestone Institute of America, Inc., 1982-1983.

E. Ramsey, Charles G., and Harold R. Sleeper. *Architectural Graphic Standards,* 6th ed. New York: John Wiley and Sons, Inc., 1970.

F. Turcotte, Raymond J. *Bricklaying Curriculum.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and Associated General Contractors of America, 1977.

STONE, SLATE, MARBLE, AND GRANITE PANELS
UNIT II

INFORMATION SHEET

I. Terms and definitions

A. Anchor — Metal device used to secure panels in place and to secure panels to each other

B. Bond breaker — Material used to prevent adhesion of newly placed stone

C. Chat-sawed — Having coarse, pebbled surface resulting from coarse abrasive used during gang-sawing operation

D. Epoxy resin — Chemical bonding material used in preparing special coatings and adhesives and as binder in some mortars and concretes

E. Grout — Fluid mixture of mortar or cement used to fill joints and depressions

F. Gusseted support — Steel plate welded to an angle iron to provide more strength to the support

G. Machine-tooled — Having parallel, concave grooves cut on the surface

H. Plucked finish — Machine finish obtained by rough-planing the surface, thus breaking or plucking out small particles, leaving an interesting rough texture

I. Reglet — Groove in a wall to receive and secure flashing

J. Sealant — Material used to seal joints to prevent moisture penetration

K. Shim — Relatively thin piece of steel used as a filler

L. Shot-sawed — Having coarse, uneven finish ranging from a pebbled surface to one ripped with irregular, roughly parallel grooves resulting from steel shot used in gang-sawing process

M. Support system — Steel angles or plates attached to building frame; designed to speed and ease erection of panels and give adequate support to panels

N. Support slots — Reglets cut into stone to provide openings for attaching anchors and supports

O. Wood wedge — Piece of wood tapering to a thin edge at one end; used to adjust and/or hold stone in position

INFORMATION SHEET

II. Reasons for using panels

  A. Conform to architectural design

  B. Provide aesthetic value

  C. Have thermal properties

  D. Are fire-resistant

  E. Are cost-effective

  (NOTE: Panels are cost-effective when used as a monolithic design on one-story application.)

  F. May be preferred by consumer

  G. Can be erected quickly

III. Physical properties of stone, slate, marble, and granite panels

(NOTE: Those properties listed below are general. Specific physical properties of stone panels depend on the type of stone, type of finish, intended use [interior/exterior], type of anchor and support system, and other factors.)

  A. Strong

  B. Relatively inelastic

  C. Light reflective

  D. Abrasion resistant

  E. Absorption resistant

  F. Sound-transmission resistant

  G. Thermal conduction/expansion resistant

IV. Types of finishes used on stone, slate, marble, and granite panels

  A. Slick or polished

  B. Smooth machined

  C. Diamond gang-sawed

  D. Plucked

INFORMATION SHEET

E. Machine- or hand-tooled

F. Chat-sawed

G. Shot-sawed

H. Split faced

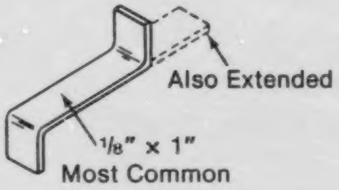
I. Rock faced

J. Custom

V. Types of anchors used to set panels (Figures 1-35)

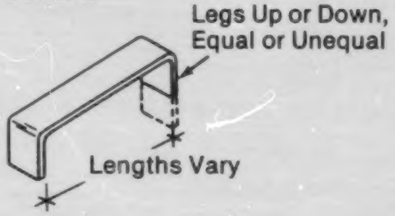
A. Strap anchor

FIGURE 1


Also Extended
1/8" x 1"
Most Common

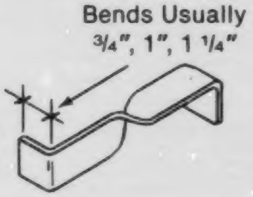
B. Cramp anchor

FIGURE 2


Legs Up or Down,
Equal or Unequal
Lengths Vary

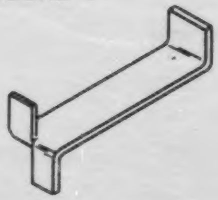
C. Twisted strap

FIGURE 3


Bends Usually
3/4", 1", 1 1/4"

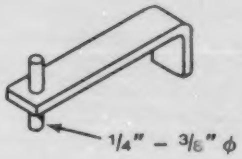
D. Two-way strap

FIGURE 4



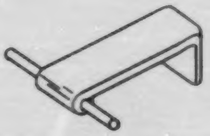
E. Strap and dowel

FIGURE 5



F. Strap and rod

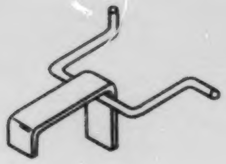
FIGURE 6



INFORMATION SHEET

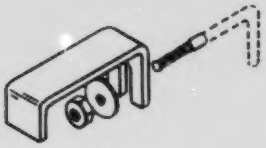
G. Clip and loop

FIGURE 7



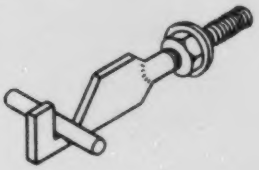
H. Slotted clip

FIGURE 8



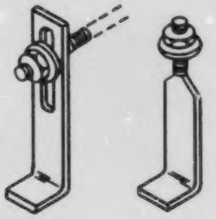
I. Flat hook and bolt

FIGURE 9



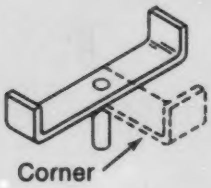
J. Soffit straps

FIGURE 10



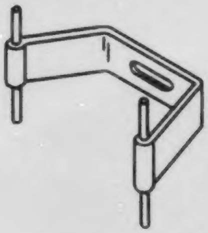
K. Cramp and dowel

FIGURE 11



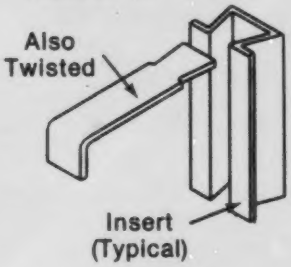
L. U-strap and rods

FIGURE 12



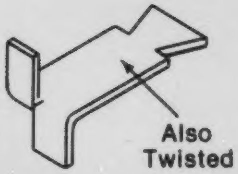
M. Dovetail anchor

FIGURE 13


Also
Twisted
Insert
(Typical)

N. Two-way dovetail

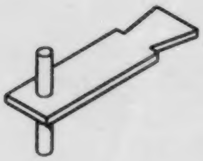
FIGURE 14


Also
Twisted

INFORMATION SHEET

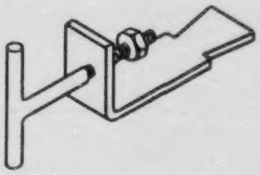
O. Dovetail and dowel

FIGURE 15



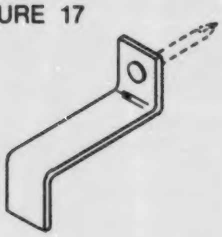
P. Dovetail clip and T-bolt

FIGURE 16



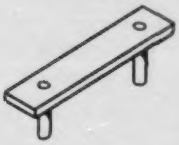
Q. Clip and power stud

FIGURE 17



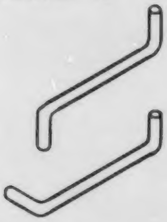
R. Strap and rod cramp

FIGURE 18



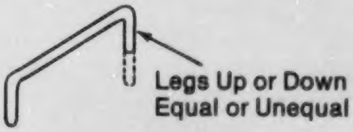
S. Rod anchors

FIGURE 19



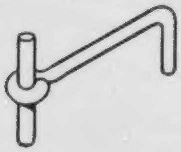
T. Rod cramp

FIGURE 20


Legs Up or Down
Equal or Unequal

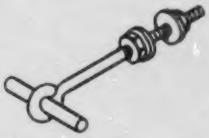
U. Eye rod and dowel

FIGURE 21



V. Eyebolt and dowel

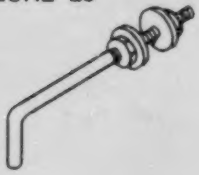
FIGURE 22



INFORMATION SHEET

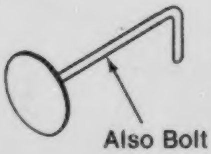
W. Hooked bolt

FIGURE 23



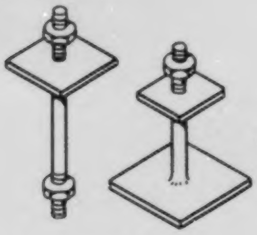
X. Disc and rod

FIGURE 24



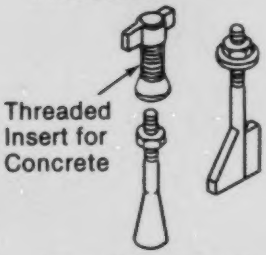
Y. Plate and bolt

FIGURE 25



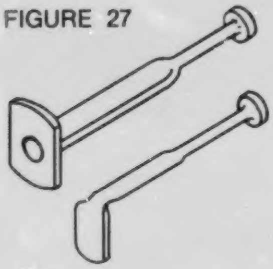
Z. Lewis bolts

FIGURE 26


Threaded
Insert for
Concrete

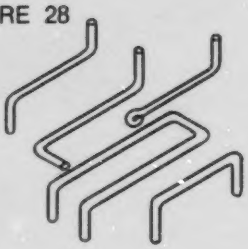
AA. Tamp-in anchor

FIGURE 27



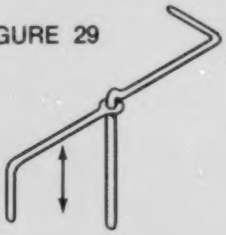
BB. Wire anchors

FIGURE 28



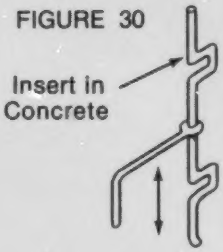
CC. Adjustable wire

FIGURE 29



DD. Adjustable insert wire

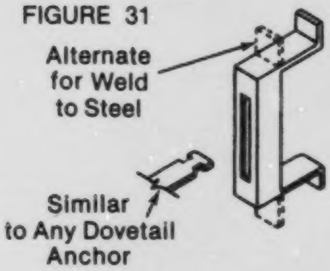
FIGURE 30


Insert in
Concrete

INFORMATION SHEET

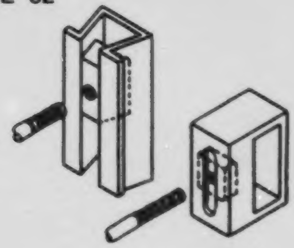
EE. Channel insert

FIGURE 31


Alternate
for Weld
to Steel
Similar
to Any Dovetail
Anchor

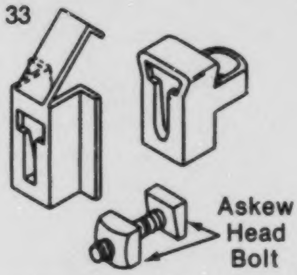
FF. Lug and nut insert

FIGURE 32



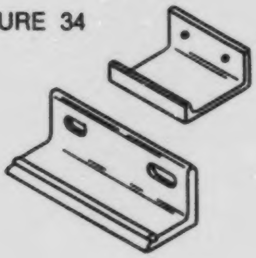
GG. Shelf-angle inserts

FIGURE 33


Askew
Head
Bolt

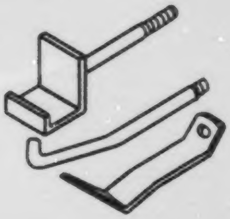
HH. Shelf angles

FIGURE 34



II. Specialty items

FIGURE 35

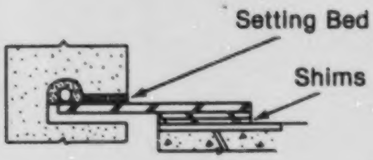


INFORMATION SHEET

VI. Types of support systems used on panels (Figures 36-45)

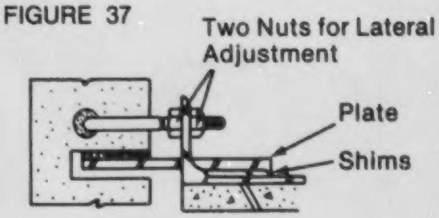
A. Plate with bar

FIGURE 36


Setting Bed
Shims

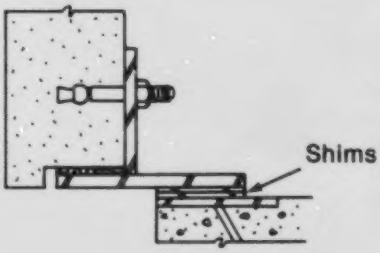
B. Clip angle

FIGURE 37


Two Nuts for Lateral Adjustment
Plate
Shims

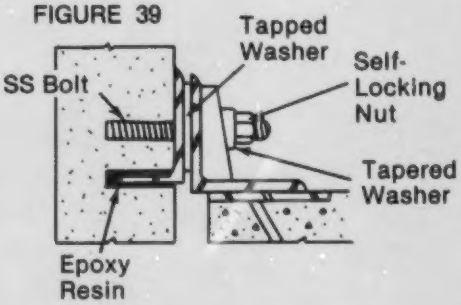
C. T-support and wedge anchor

FIGURE 38



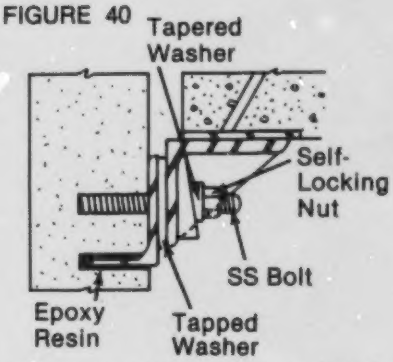
D. Angle epoxied into stone for supports above floor

FIGURE 39


Tapped Washer
SS Bolt
Self-Locking Nut
Tapered Washer
Epoxy Resin

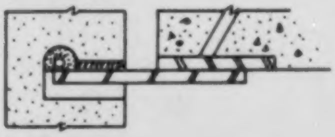
E. Angle epoxied into stone for supports below floor

FIGURE 40


Tapered Washer
Self-Locking Nut
SS Bolt
Epoxy Resin
Tapped Washer

F. Plate and rod for supports below floor

FIGURE 41

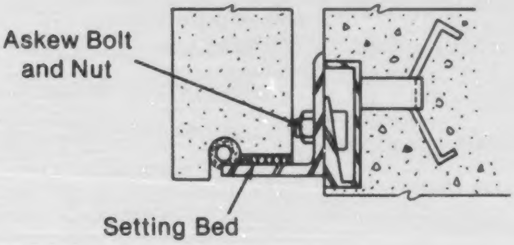


Figures 36-41 used with permission of the Indiana Limestone Institute of America, Inc., Bedford, Indiana.

INFORMATION SHEET

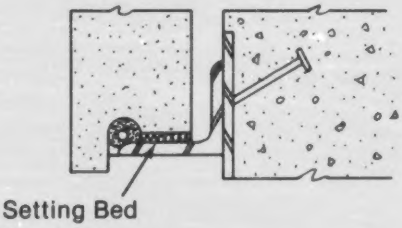
G. Angle and rod with adjustable concrete insert

FIGURE 42


Askew Bolt and Nut
Setting Bed

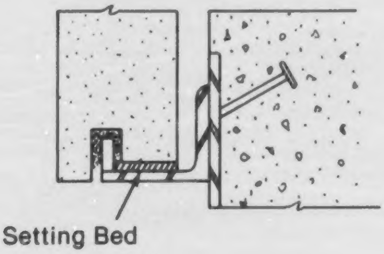
H. Angle with rod and weld plate

FIGURE 43


Setting Bed

I. Clip angle with bar and weld plate

FIGURE 44

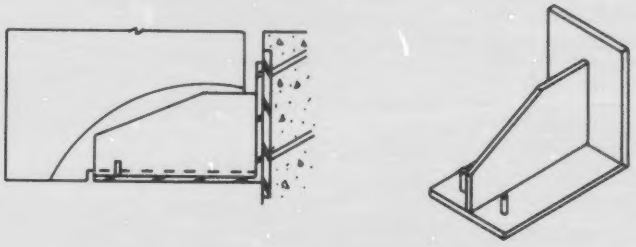

Setting Bed

Figures 42-44 used with permission of the Indiana Limestone Institute of America, Inc., Bedford, Indiana.

INFORMATION SHEET

J. Gusseted support with dowels

FIGURE 45

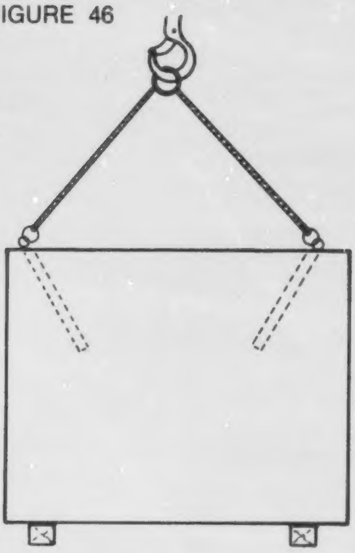


Used with permission of the Indiana Limestone Institute of America, Inc., Bedford, Indiana.

VII. Devices used to handle panels (Figures 46-49)

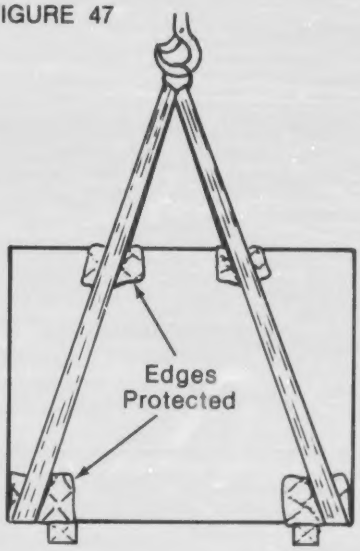
A. Lewis pins and bridle

FIGURE 46



B. Straps

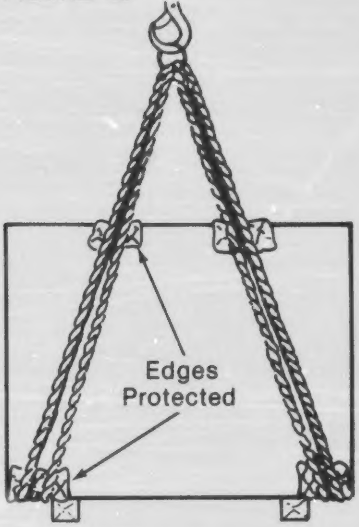
FIGURE 47



INFORMATION SHEET

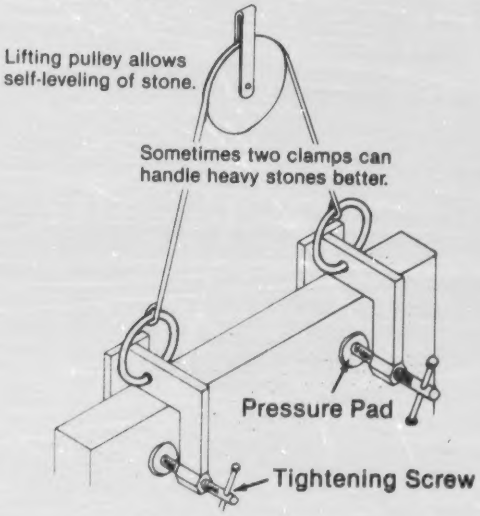
C. Chokers (slings)

FIGURE 48


Edges
Protected

D. Stone clamps

FIGURE 49


Lifting pulley allows self-leveling of stone.
Sometimes two clamps can handle heavy stones better.
Pressure Pad
Tightening Screw

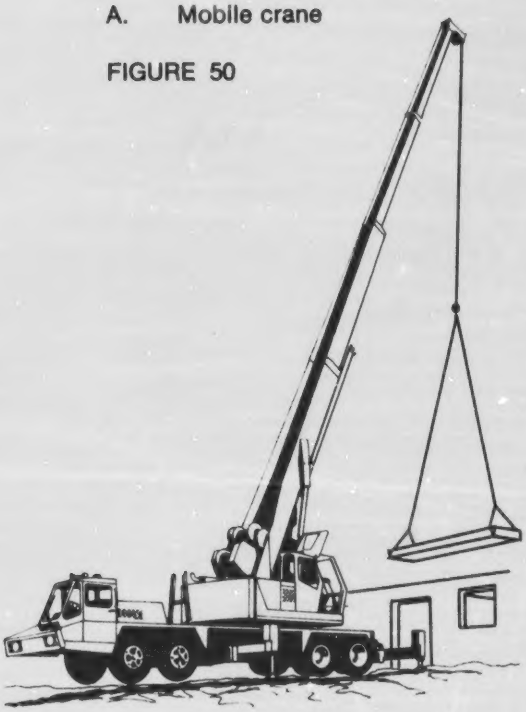
Used with permission of the Indiana Limestone Institute of America, Inc., Bedford, Indiana.

INFORMATION SHEET

VIII. Types of equipment used to set panels (Figures 50-57)

A. Mobile crane

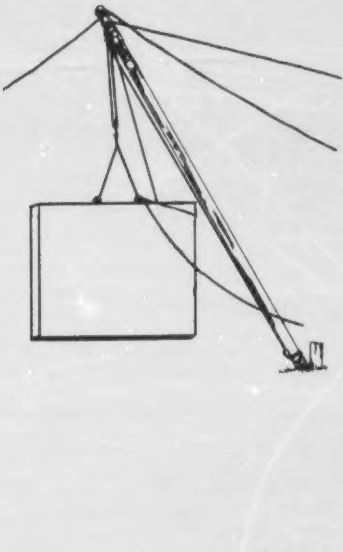
FIGURE 50



Adapted with permission of the Construction Safety Association of Ontario.

B. Gin pole

FIGURE 51



INFORMATION SHEET

C. Stone-setter's derrick

FIGURE 52

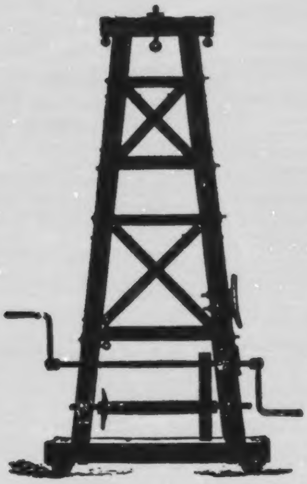
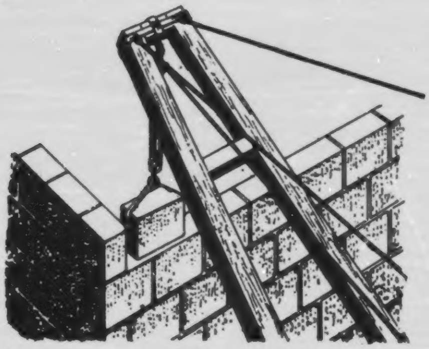


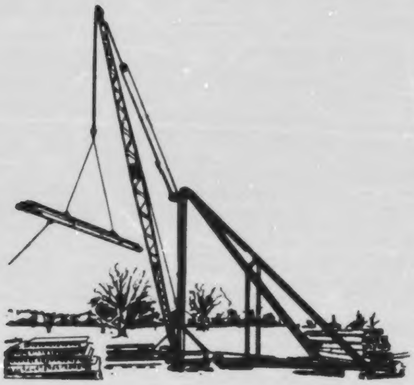
FIGURE 53



Figures 52 and 53 used with permission of The Bobbs-Merrill Company, Inc., Indianapolis, Indiana.

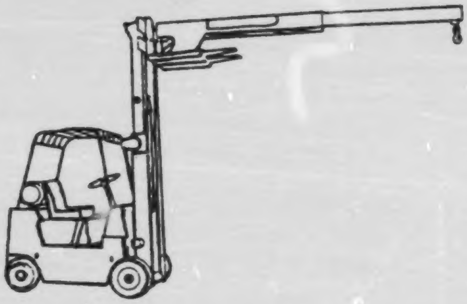
D. Stiffleg derrick

FIGURE 54



E. Forklift

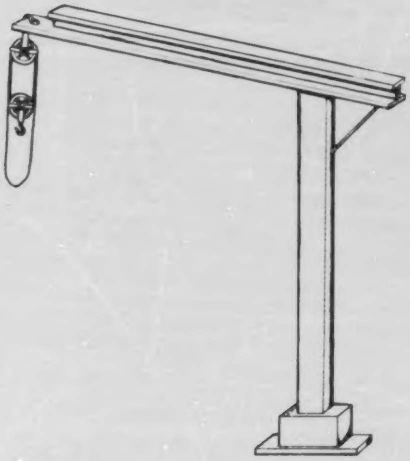
FIGURE 55



INFORMATION SHEET

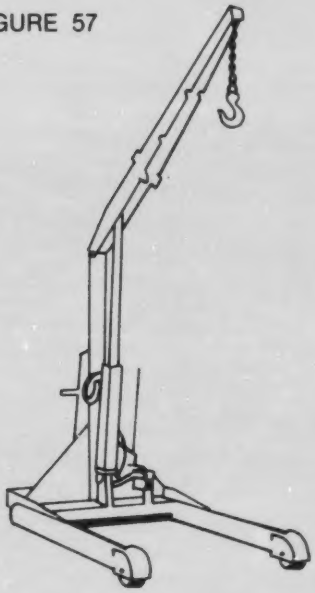
F. Jib crane

FIGURE 56



G. Floor crane

FIGURE 57



IX. Guidelines for setting stone, slate, marble, and granite panels

A. Clean stone with mild soap powder or detergent, clean water, and fiber brush, or use approved mechanical cleaning process

(NOTE: If not practical to clean uninstalled panels, stone may be cleaned after erection.)

B. Rinse stone thoroughly with clean water

C. Use anchors and/or supports as specified by architect

D. Use nonstaining mortar when setting stone

(NOTE: Mortar shall be composed of one part nonstaining cement [ASTM-C91]; one part hydrated lime [ASTM-C207, Type S]; and six parts clean, sharp, washed sand [ASTM-C144].)

INFORMATION SHEET

E. Use soft, water-soaked wood wedges

F. Set panels level, plumb, square, and in proper alignment, maintaining proper joints

(NOTE: Unless otherwise specified, all joints shall be $^{3}/_{8}$-inch.)

G. Rake out mortar joints enough to accept backup material or bond breaker plus sealant

H. Secure anchors by filling all anchor and support slots with mortar, lead wool, approved shim stock, or other approved material

(NOTE: A noncorrosive shim stock may be used, providing it is not built up beyond a snug thickness; also various types of sealants and nonshrinkable grouts may be used if proper precautions are followed.)

I. Keep face of stone clean

J. Repair or patch where needed

(NOTE: Repairing is an accepted practice if it is done according to industry standards.)

K. Set stone accurately in strict accordance with contract and shop drawings

X. Protection requirements for different temperatures during cold-weather construction

(NOTE: The following standards may be used if no specifications are given.)

A. Temperature above 40°F — Cover walls with plastic or canvas at end of workday to prevent moisture from entering masonry

B. Temperature 40°F to 32°F — Cover walls and materials with waterproof erings to prevent materials from getting wet and freezing

C. Temperature 32°F to 25°F — Provide windbreaks during day, and cover walls and materials at end of workday to prevent materials from getting wet and freezing

D. Temperature 25°F to 20°F — Use auxiliary heat or insulated blankets to maintain materials and masonry above freezing for at least sixteen hours

E. Temperature 20°F to 0°F — Provide heated enclosure to maintain a temperature above 32°F for at least twenty-four hours

INFORMATION SHEET

XI. Qualities of mortar in finished walls

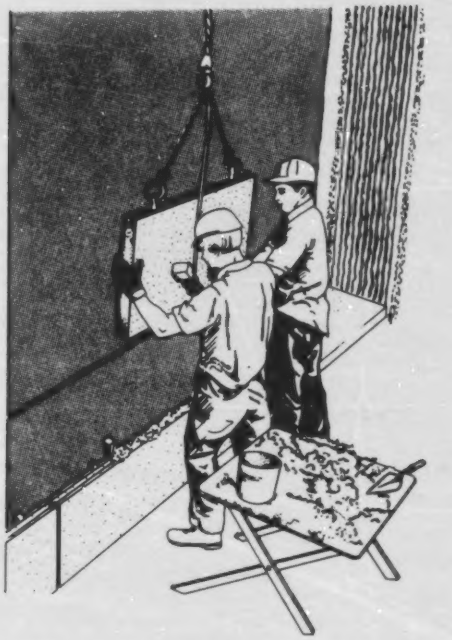
- A. Compressive strength
- B. Bond strength
- C. Durability

XII. Factors to consider prior to using stone, slate, marble, or granite panels

- A. Cost
- B. Availability
- C. Strength
- D. Aesthetic value
- E. Climatic conditions
- F. Durability
- G. Physical properties
- H. Performance characteristics

STONE, SLATE, MARBLE, AND GRANITE PANELS
UNIT II

JOB SHEET #1 — CONSTRUCT A STONE WALL, USING STONE PANELS WITH RAKED JOINTS



I. Equipment and materials

- A. Appropriate lifting equipment
- B. Lewis pins and bridle
- C. Anchors (as specified)
- D. Wood wedges
- E. Trowel
- F. Stonemason's hammer
- G. Chisel
- H. Brickmason's level
- I. Rule or tape

JOB SHEET #1

J. Mortarboard and stand

K. Mortar box

L. Hoe

M. Square-point shovel

N. Water bucket and water

O. Stone panels

P. Nonstaining mortar

Q. Fiber brush

R. Water hose

S. Specifications furnished by instructor

T. Joint rake

U. Safety equipment

(NOTE: If wall is scaffold-high, scaffolding should be in accordance with OSHA regulations, and workers should wear a safety harness.)

II. Procedure

A. Mix mortar

B. Check drawings to confirm number of first stone

C. Check stones and select one with number corresponding to drawings

(NOTE: Drawings will show number of each stone, and all stones will be marked with a corresponding number.)

D. Insert lewis pins in stone

E. Attach bridle to lifting equipment

F. Clean area where stone will be set

G. Apply a full bed of mortar to bed joint

H. Hold stone while it is being moved into position

JOB SHEET #1

I. Set stone in its exact location on bed joint

(NOTE: Depending on size of stone, you may need to use water-soaked wood wedges to keep weight of stone from squeezing all of the mortar out of the joint.)

J. Disconnect lewis pins from stone

K. Level and plumb stone

L. Maintain $^{3}/_{8}$-inch joints unless otherwise noted

M. Continue to follow procedure in steps C through K to set remainder of stones

(NOTE: As job progresses, be sure to anchor all stones that have been cut or drilled for anchors and to use anchors as specified.)

N. Tuck-point vertical joints

O. Clean each stone after it has been set

P. Clean up around wall after completion

Q. Clean and put away all equipment and materials

STONE, SLATE, MARBLE, AND GRANITE PANELS
UNIT II

TEST

NAME ______________________________ SCORE ______________

1. Match to their correct definitions terms associated with stone, slate, marble, and granite panels. Write the correct numbers in the blanks. Definitions continue on the following page.

______a. Steel angles or plates attached to building frame; designed to speed and ease erection of panels and give adequate support to panels

______b. Material used to seal joints to prevent moisture penetration

______c. Metal device used to secure panels in place and to secure panels to each other

______d. Steel plate welded to an angle iron to provide more strength to the support

______e. Reglets cut into stone to provide openings for attaching anchors and supports

______f. Material used to prevent adhesion of newly placed stone

______g. Piece of wood tapering to a thin edge at one end; used to adjust and/or hold stone in position

______h. Fluid mixture of mortar or cement used to fill joints and depressions

______i. Having coarse, uneven finish ranging from a pebbled surface to one ripped with irregular, roughly parallel grooves resulting from steel shot used in gang-sawing process

______j. Having coarse, pebbled surface resulting from coarse abrasive used during gang-sawing operation

______k. Relatively thin piece of steel used as a filler

______l. Groove in a wall to receive and secure flashing

1. Anchor
2. Bond breaker
3. Chat-sawed
4. Epoxy resin
5. Grout
6. Gusseted support
7. Machine-tooled
8. Plucked finish
9. Sealant
10. Shot-sawed
11. Support slots
12. Support system
13. Wood wedge
14. Reglet
15. Shim

TEST

_____m. Machine finish obtained by rough-planing the surface, thus breaking or plucking out small particles, leaving an interesting rough texture

_____n. Chemical bonding material used in preparing special coatings and adhesives and as binder in some mortars and concretes

_____o. Having parallel, concave grooves cut on the surface

2. Select from the following list reasons for using panels. Write an "X" in the blank before each correct answer.

_____a. Are cheap

_____b. May be preferred by consumer

_____c. Have thermal properties

_____d. Conform to architectural design

_____e. Are waterproof

_____f. Reduce heat

_____g. Are fire-resistant

_____h. Provide aesthetic value

_____i. Can be erected quickly

3. State five physical properties of stone, slate, marble, and granite panels.

a. ____

b. ____

c. ____

d. ____

e. ____

TEST

4. List five types of finishes used on stone, slate, marble, and granite panels.

   a. ______________________________

   b. ______________________________

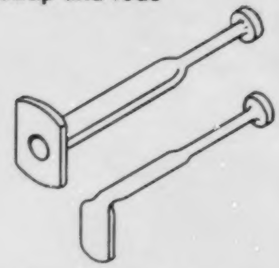
   c. ______________________________

   d. ______________________________

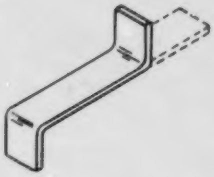
   e. ______________________________

5. Identify the following types of anchors used to set panels. Write the correct names in the blanks.

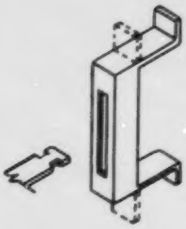
Strap and dowel
Clip and loop
Cramp and dowel
Dovetail and dowel
Soffit straps
Dovetail clip and T-bolt
Disc and rod
Lug and nut insert
Strap anchor
Flat hook and bolt
Channel insert
Strap and rod
U-strap and rods
Dovetail anchor
Clip and power stud
Rod anchors
Shelf-angle inserts
Slotted clip
Strap and rod cramp
Eyebolt and dowel
Adjustable insert wire
Hooked bolt
Tamp-in anchor
Specialty items
Two-way strap
Two-way dovetail
Lewis bolts
Shelf angles
Twisted strap
Adjustable wire
Rod cramp
Wire anchors
Cramp anchor
Eye rod and dowel
Plate and bolt



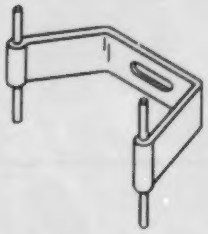
a. ______________________________



b. ______________________________

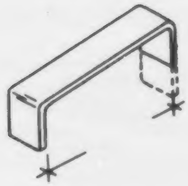


c. ______________________________

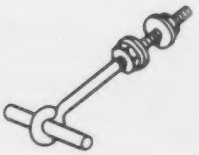


d. ______________________________

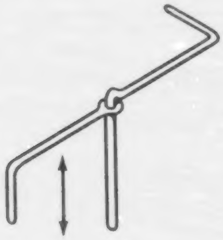
TEST



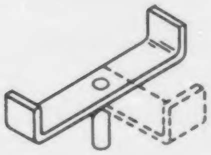
e. ______________________________



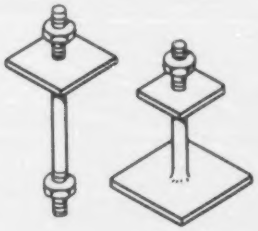
f. ______________________________



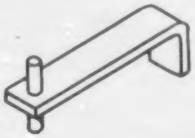
g. ______________________________



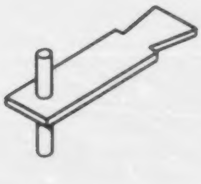
h. ______________________________



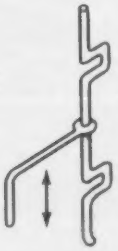
i. ______________________________



j. ______________________________

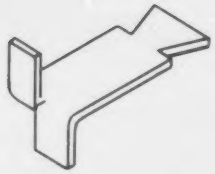


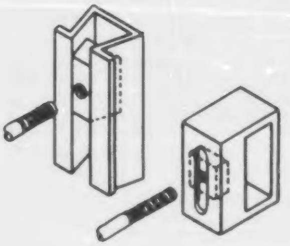
k. ______________________________



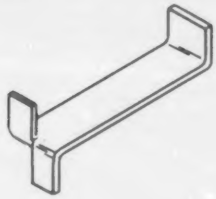
l. ______________________________

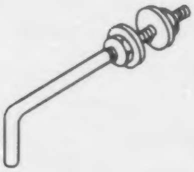
TEST



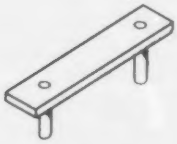


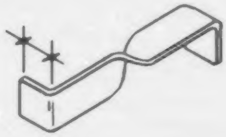
m. ______________________________ n. ______________________________



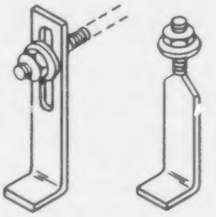


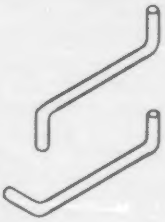
o. ______________________________ p. ______________________________





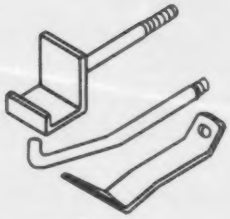
q. ______________________________ r. ______________________________

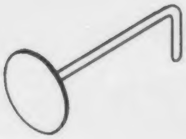




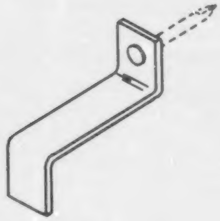
s. ______________________________ t. ______________________________

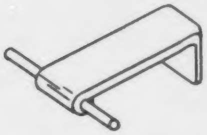
TEST



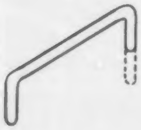


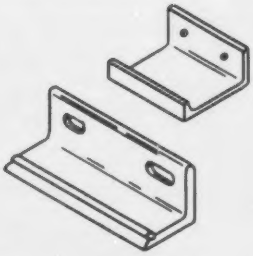
u. ______________________________ v. ______________________________



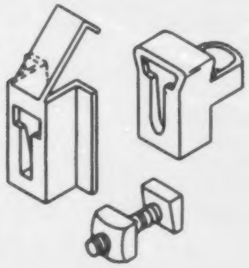


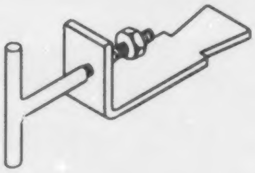
w. ______________________________ x. ______________________________





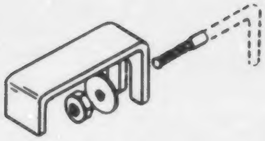
y. ______________________________ z. ______________________________



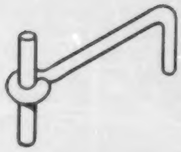


aa. ______________________________ bb. ______________________________

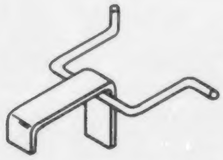
TEST



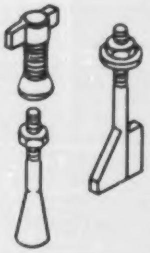
cc. ______________________________



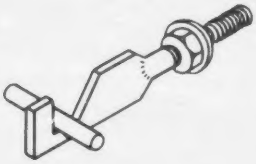
dd. ______________________________



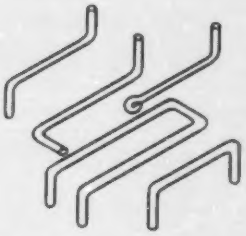
ee. ______________________________



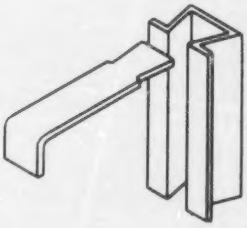
ff. ______________________________



gg. ______________________________



hh. ______________________________

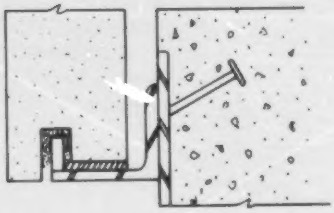


ii. ______________________________

TEST

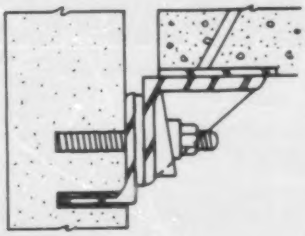
6. Identify the following types of support systems used on panels. Write the correct names in the blanks.

Angle and rod with adjustable concrete insert
Angle epoxied into stone for supports below floor
Clip angle with bar and weld plate
Angle epoxied into stone for supports above floor
Plate and rod for supports below floor
Angle with rod and weld plate
T-support and wedge anchor
Gusseted support with dowels
Plate with bar
Clip angle



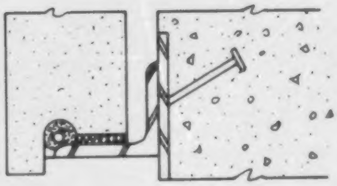
a. ______________________________

____



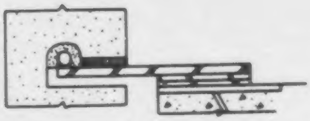
b. ______________________________

____



c. ______________________________

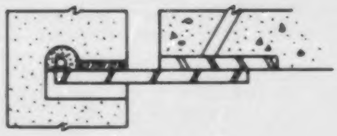
____



d. ______________________________

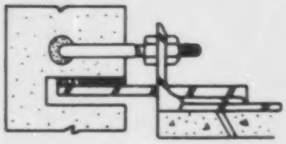
____

TEST



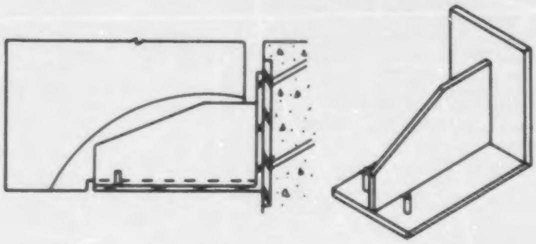
e. ______________________________

____



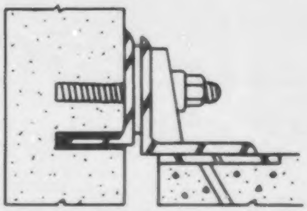
f. ______________________________

____



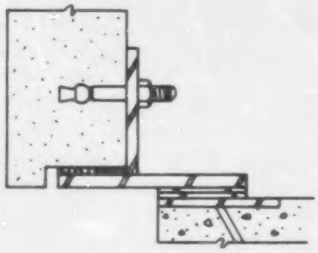
g. ______________________________

____



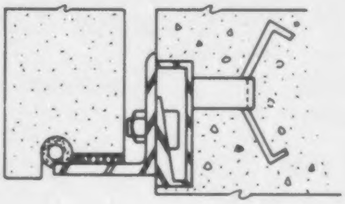
h. ______________________________

____



i. ______________________________

____

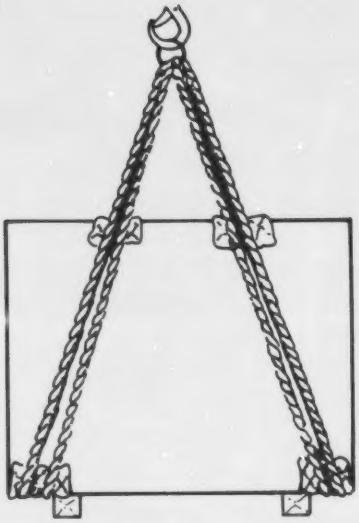


j. ______________________________

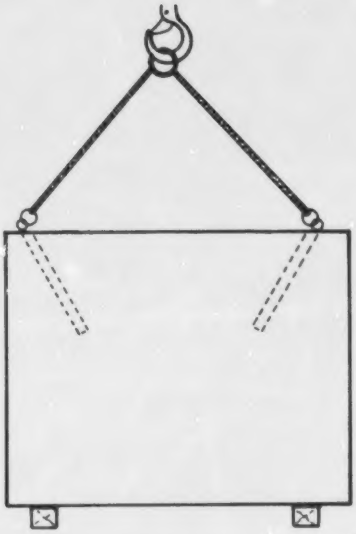
____

TEST

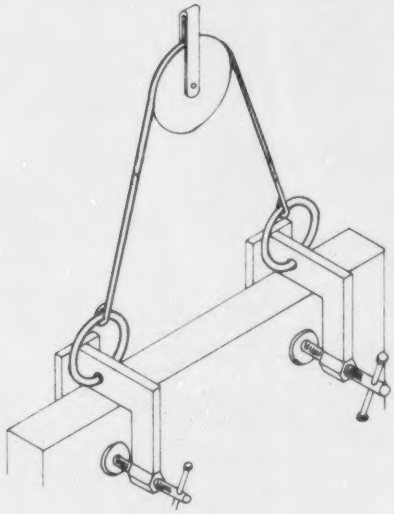
7. Label the following devices used to handle panels.



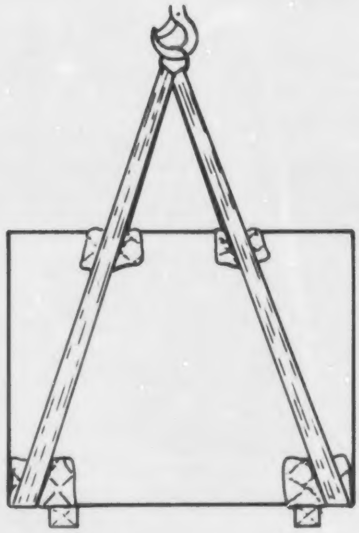
a. ______________________________



b. ______________________________



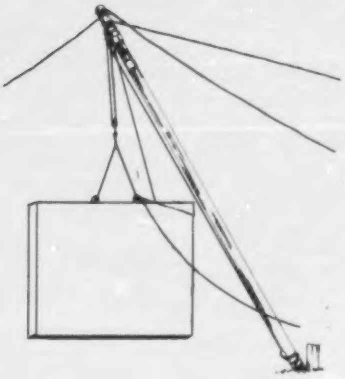
c. ______________________________

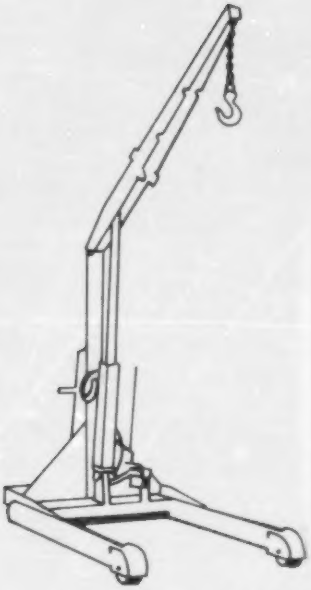


d. ______________________________

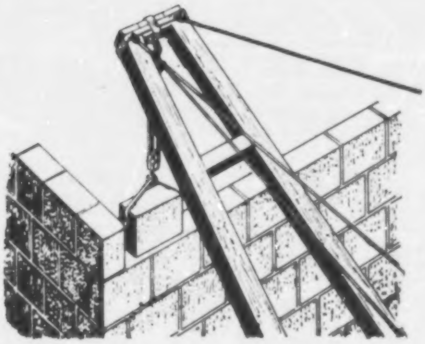
TEST

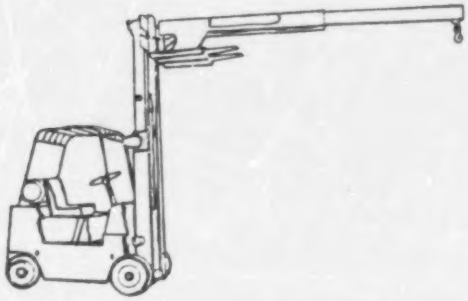
8. Label the following types of equipment used to set panels.





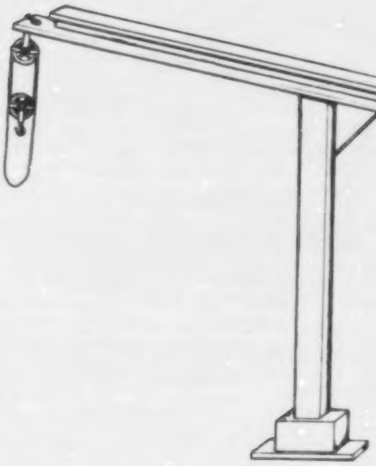
a. ______________________________ b. ______________________________



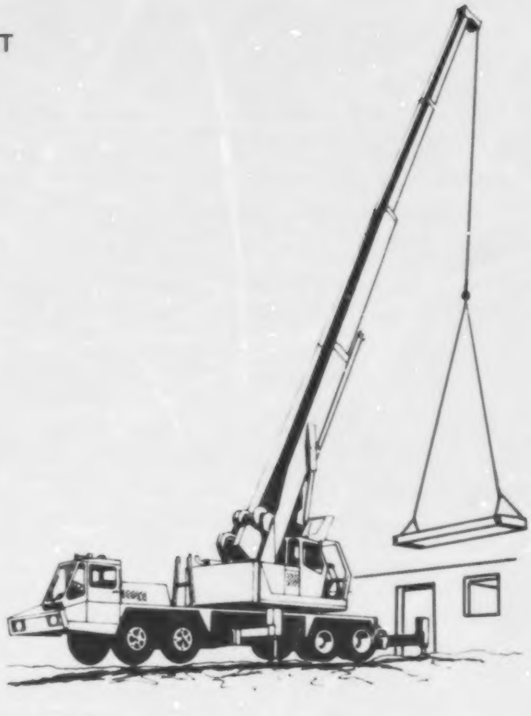


c. ______________________________ d. ______________________________

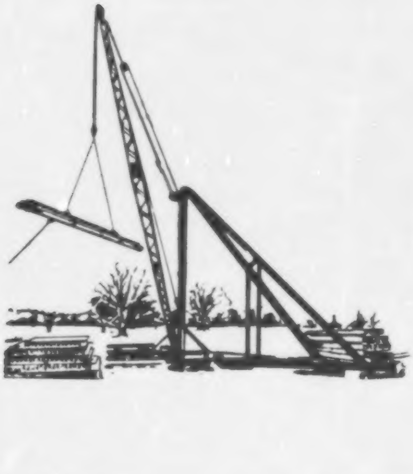
TEST



e. ______________________________



f. ______________________________



g. ______________________________

TEST

9. State five guidelines for setting stone, slate, marble, and granite panels.

a. ______________________________

____

b. ______________________________

____

c. ______________________________

____

d. ______________________________

____

e. ______________________________

____

10. Match temperatures to the correct protection requirements for cold-weather construction. Write the correct numbers in the blanks

_____a. Provide heated enclosure to maintain a temperature above 32°F for at least twenty-four hours

_____b. Use auxiliary heat or insulated blankets to maintain materials and masonry above freezing for at least sixteen hours

_____c. Provide windbreaks during day, and cover walls and materials at end of workday to prevent materials from getting wet and freezing

_____d. Cover walls with plastic or canvas at end of workday to prevent moisture from entering masonry

_____e. Cover walls and materials with waterproof coverings to prevent materials from getting wet and freezing

1. 25°F to 20°F
2. Above 40°F
3. 20°F to 0°F
4. 40°F to 32°F
5. 32°F to 25°F

TEST

11. State qualities of mortar in finished walls.

    a. ______________________________

    b. ______________________________

    c. ______________________________

12. State four factors to consider prior to using stone, slate, marble, or granite panels.

    a. ______________________________

    b. ______________________________

    c. ______________________________

    d. ______________________________

(NOTE: Test question 13 lists the job sheet. It is an important part of this test. If it has not been completed, check with your instructor.)

13. Demonstrate the ability to construct a stone wall, using stone panels with raked joints.

STONE, SLATE, MARBLE, AND GRANITE PANELS
UNIT II

ANSWERS TO TEST

1.

a.	12	f.	2	k.	15
b.	9	g.	13	l.	14
c.	1	h.	5	m.	8
d.	6	i.	10	n.	4
e.	11	j.	3	o.	7

2. b, c, d, g, h, i

3. Answer should include any five of the following

   a. Strong

   b. Relatively inelastic

   c. Light reflective

   d. Abrasion resistant

   e. Absorption resistant

   f. Sound-transmission resistant

   g. Thermal conduction/expansion resistant

4. Answer should include any five of the following

   a. Slick or polished

   b. Smooth machined

   c. Diamond gang-sawed

   d. Plucked

   e. Machine- or hand-tooled

   f. Chat-sawed

   g. Shot-sawed

   h. Split faced

   i. Rock faced

   j. Custom

ANSWERS TO TEST

5. a. Tamp-in anchor
   b. Strap anchor
   c. Channel insert
   d. U-strap and rods
   e. Cramp anchor
   f. Eyebolt and dowel
   g. Adjustable wire
   h. Cramp and dowel
   i. Plate and bolt
   j. Strap and dowel
   k. Dovetail and dowel
   l. Adjustable insert wire
   m. Two-way dovetail
   n. Lug and nut insert
   o. Two-way strap
   p. Hooked bolt
   q. Strap and rod cramp
   r. Twisted strap
   s. Soffit straps
   t. Rod anchors
   u. Specialty items
   v. Disc and rod
   w. Clip and power stud
   x. Strap and rod
   y. Rod cramp
   z. Shelf angles
   aa. Shelf-angle inserts
   bb. Dovetail clip and T-bolt
   cc. Slotted clip
   dd. Eye rod and dowel
   ee. Clip and loop
   ff. Lewis bolts
   gg. Flat hook and bolt
   hh. Wire anchors
   ii. Dovetail anchor

6. a. Clip angle with bar and weld plate
   b. Angle epoxied into stone for supports below floor
   c. Angle with rod and weld plate
   d. Plate with bar
   e. Plate and rod for supports below floor
   f. Clip angle

ANSWERS TO TEST

g. Gusseted support with dowels

h. Angle epoxied into stone for supports above floor

i. T-support and wedge anchor

j. Angle and rod with adjustable concrete insert

7. a. Chokers (slings)

   b. Lewis pins and bridle

   c. Stone clamps

   d. Straps

8. a. Gin pole

   b. Floor crane

   c. Stone-setter's derrick

   d. Forklift

   e. Jib crane

   f. Mobile crane

   g. Stiffleg derrick

9. Answer should include any five of the following

   a. Clean stone with mild soap powder or detergent, clean water, and fiber brush, or use approved mechanical cleaning process

   b. Rinse stone thoroughly with clean water

   c. Use anchors and/or supports as specified by architect

   d. Use nonstaining mortar when setting stone

   e. Use soft, water-soaked wood wedges

   f. Set panels level, plumb, square, and in proper alignment, maintaining proper joints

   g. Rake out mortar joints enough to accept backup material or bond breaker plus sealant

ANSWERS TO TEST

h. Secure anchors by filling all anchor and support slots with mortar, lead wool, approved shim stock, or other approved material

i. Keep face of stone clean

j. Repair or patch where needed

k. Set stone accurately in strict accordance with contract and shop drawings

10. a. 3
b. 1
c. 5
d. 2
e. 4

11. a. Compressive strength
b. Bond strength
c. Durability

12. Answer should include any four of the following
a. Cost
b. Availability
c. Strength
d. Aesthetic value
e. Climatic conditions
f. Durability
g. Physical properties
h. Performance characteristics

13. Performance skills evaluated to the satisfaction of the instructor

WALL AND FLOOR TILE
UNIT III

UNIT OBJECTIVE

After completing this unit, the student should be able to choose the correct type of mortar and grout and install wall and floor tile. The student will show this knowledge by completing the job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with wall and floor tile.
2. List general areas where tile is used.
3. State factors affecting tile selection and installation.
4. Select from a list physical characteristics of tile.
5. Name major types of floor and wall tile.
6. Describe types of glazes.
7. Select from a list guidelines for layout.
8. Select from a list guidelines for floor and wall installation.
9. Match types of mortars to their correct descriptions.
10. Match types of grouts to their correct descriptions.
11. Select from a list guidelines for mixing and using grout.
12. Select from a list characteristics of good grouting.
13. State reasons for grout discoloration.
14. Select from a list ways to prevent grout discoloration.
15. Match to their correct descriptions special products used in tile installation.
16. Select from a list locations where expansion joints should be used.
17. Describe cleaning methods used prior to setting tile over tile.

OBJECTIVE SHEET

18. Demonstrate the ability to
    - a. Install floor tile on concrete base.
    - b. Install wall tile on masonry wall.

WALL AND FLOOR TILE
UNIT III

SUGGESTED ACTIVITIES

I. Suggested activities

- A. Gather equipment and materials for job sheet demonstrations.
- B. Gather samples of different types of wall and floor tiles.
- C. Provide students with objective sheet.
- D. Discuss unit and specific objectives.
- E. Provide students with information and job sheets.
- F. Discuss information sheet.
- G. Inform students that all specifications for ceramic tile installation must conform to local building codes, ordinances, trade practices, and climatic conditions.
- H. Provide students with techniques, hints, and job skills essential and unique to installing tile.

  (NOTE: It may be helpful to obtain a current copy of the *Handbook for Ceramic Tile Installation* for each student. The handbook is available from Tile Council of America, Inc., P. O. Box 326, Princeton, New Jersey 08540.)
- I. Show students a variety of tiles and explain the differences among them.
- J. Take students on a field trip to observe tile installation in progress.
- K. Demonstrate and discuss procedures outlined in job sheets.
- L. Provide equipment and materials so that students may accomplish procedures outlined in job sheets.
- M. Provide students with specifications or job plans for job sheets.
- N. Give test.
- O. Complete appropriate section of competency profiles.

  (NOTE: Competency profiles are available from AGC and CIMC.)

II. Instructional materials

- A. Objective sheet

SUGGESTED ACTIVITIES

B. Suggested activities

C. Information sheet

D. Job sheets

   1. Job Sheet #1 — Install Floor Tile on Concrete Base

   2. Job Sheet #2 — Install Wall Tile on Masonry Wall

E. Test

F. Answers to test

III. Unit references

A. *Gail Architectural Ceramics.* San Francisco, California: Gail International Corporation, n.d.

B. *1983 Handbook for Ceramic Tile Installation.* Princeton, New Jersey: Tile Council of America, Inc., 1983.

WALL AND FLOOR TILE
UNIT III

INFORMATION SHEET

I. Terms and definitions

A. Absorption — Process that allows tile to take in or absorb moisture

B. Adhesive — Compound used to bond or stick materials together

C. Aesthetic — Relating to or dealing with beauty; artistic

D. Bond coat — Material used to adhere tile to a prepared surface

E. Butter — To spread a bond coat on the back of a tile just before tile is placed

F. Ceramic tile — Manufactured tile made essentially from a nonmetallic mineral by firing at high temperature

G. Dry pack — Very dry mortar mix; mixture is correct when a handful is squeezed and just sticks together without showing any apparent moisture

H. Dust-pressed — Process of forming a tile body by pressing into shape material of low moisture, almost dust-like consistency

I. Efflorescence — Residue deposited on the surface of a material by the crystallization of soluble salts

J. Expansion joint — Gap left between sections of materials to permit expansion or contraction without cracking

K. Extrusion process — Process used to form tile by forcing plastic clay mixture through an opening of suitable configuration to shape a continuous ribbon of formed clay that is cut to appropriate lengths and widths

L. Glazed tile — Tile with a fused impervious facial finish composed of ceramic materials fused to the body of the tile, which may be nonvitreous, semivitreous, vitreous, or impervious

M. Grout — Modified portland cement or noncement-based material used for filling joints

N. Hawk — Tool used to hold or carry mortar; flat piece of wood or metal with a handle centered and fixed to the underside

O. Haze — Cloudy film that may appear on tiles after grouting

P. Impervious — Characterized by water absorption of 0.5 percent or less

INFORMATION SHEET

Q. Kraft paper — Strong paper made from wood pulp processed with sodium sulfate

R. Latex — Water emulsion of synthetic rubber or plastic obtained by polymerization; used in coatings and adhesives

S. Permeable — Able to be penetrated by liquid or vapor

T. Polymerization — Reaction in which two or more molecules combine to form a compound containing the same elements in the same proportions, but of higher molecular weight

U. Potable — Fit to drink; drinkable

V. Screed — To strike off concrete lying above the desired plane or shape

W. Starting line — Squared line where tile is to start

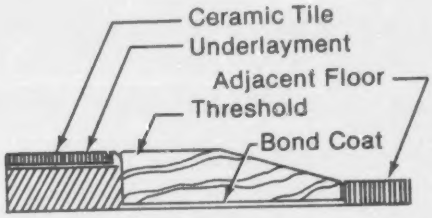
X. Strike — To compact and smooth grout line with a striking tool

(NOTE: Strike may also be called *tool.*)

Y. Threshold — Tile, stone, marble, or slate piece used to join floors of different heights; sometimes called a *saddle* (Figure 1)

EXAMPLE:

FIGURE 1



Z. Underlayment patching — Filler material consisting of latex additive and mortar; used to fill uneven spaces during preparation of masonry surface

AA. Unglazed tile — Hard dense tile of uniform composition throughout; derives color and texture from materials of which the body is made

BB. Veneer — Protective glaze or ornamental facing

CC. Vitreous — Characterized by water absorption of more than 0.5 percent, but not more than 3.0 percent

INFORMATION SHEET

II. General areas where tile is used

- A. Residential kitchens, bathrooms, and cabinet tops
- B. Commercial kitchens, bathrooms, reception areas, and corridors
- C. Institutional kitchens, bathrooms, dining areas, cabinet tops, and corridors
- D. Hospital kitchens, operating rooms, laboratories, reception areas, and corridors
- E. Food plants
- F. Bottling plants
- G. Packing plants
- H. Breweries
- I. Dairies
- J. Cheese factories
- K. Shopping malls
- L. Receiving and shipping areas
- M. Walks, patios, and decks

III. Factors affecting tile selection and installation

- A. Cost
- B. Location
- C. Physical properties
- D. Performance characteristics
- E. Aesthetic value
- F. Architectural design
- G. Type, color, size, and texture of tile
- H. Personal preference

IV. Physical characteristics of tiles

- A. Minimum maintenance
- B. Frostproof

INFORMATION SHEET

C. Stain resistant

D. Slip resistant (floor type)

E. Absorption resistant

F. Acid and alkali resistant

G. Chemical and bacteria resistant

H. Abrasion resistant

I. Fire resistant

J. Wear resistant

K. Impact and pressure resistant

INFORMATION SHEET

V. Major types of wall and floor tile

Type of Tile	Brief Description	Characteristics	Uses
Wall	Glazed tile with a body that is suitable for interior use and which is usually nonvitreous, and is not required nor expected to withstand excessive impact or be subjected to freezing and thawing conditions	Good surface hardness Easy to clean and maintain Fire resistant Chemically resistant to household acids	Interior walls and ceilings; light-duty floors and counter tops
Mosaic	Tile formed by either dust-pressed or plastic method; usually 1/4" to 3/8" thick and having a facial area of less than 6 square inches; may be of either porcelain or natural clay composition, and may be either plain or with an abrasive mixture throughout	Nonstaining Excellent wearing qualities	Floors, walls, ceilings, and counter tops; interior or exterior
Quarry	Glazed or unglazed tile made by extrusion process from natural clay or shale; usually has 6 square inches or more of facial area	Excellent wear under hard service conditions	Floors, walls, ceilings, and counter tops; interior or exterior
Paver	Glazed or unglazed porcelain or natural clay tile formed by the dust-pressed method having 6 square inches or more of facial area	Excellent wear under hard service conditions	Floors, walls, ceilings, and counter tops; interior or exterior

INFORMATION SHEET

VI. Types of glazes

- A. Bright — High gloss glaze with or without color
- B. Matte — Low gloss glaze with or without color
- C. Crystalline — Extra heavy glaze produced for use on counter tops and light-duty floor surfaces where abrasion or impact is not excessive

VII. Guidelines for layout

- A. Avoid cuts of less than one-half tile
- B. If at all possible, center layout at most conspicuous area
- C. Use actual tiles placed loosely on field
- D. Double-check all calculations and measurements
- E. If possible, show owner proposed layout before installing tile
- F. Square starting lines and compensate for out-of-square field at cuts

VIII. Guidelines for floor and wall installation

- A. Read and follow specifications and plans carefully
- B. Inspect area to be tiled

  (NOTE: Area should be clean, structurally sound, have little deflection, and be free of holes and uneven places.)
- C. Accurately measure area for tile layout
- D. Avoid using tile cutter or making cuts on tiled area

  (NOTE: Small chips may get under tile that you will be installing.)
- E. Avoid putting undue pressure on newly installed tile

  (NOTE: Pressure will cause tile to slip out of line or may break the bond between tile and setting material.)
- F. Keep tile joints straight and of even width
- G. Clean all surfaces as you go
- H. Follow manufacturer's directions carefully with each product

INFORMATION SHEET

I. When installing floor, work toward exit so that the last tiles are installed at exit

J. When installing floor, use kneeling board if it becomes necessary to work on tiled surface

IX. Types of mortars and their descriptions

A. Latex-portland cement — Mixture of portland cement, sand, and special latex additive; used as a bond coat for setting tile

(NOTE: Always use *sanded* dry-set or latex-portland cement mortars in preference to unsanded.)

B. Dry-set mortar — Mixture of portland cement with sand and additives imparting water retentivity; used as a bond coat for setting tile

C. Portland cement — ASTM C-150, Type 1

(NOTE: There are other types of materials used to set tile, such as epoxy, emulsion, furan, and organic adhesives, but these are usually used by tile setters and not by bricklayers.)

X. Types of grouts and their descriptions

A. Commercial portland cement — Mixture of portland cement and other ingredients to produce a water-resistant, dense, uniformly colored material

B. Sand-portland cement — On-the-job mixture of one part portland cement to one part fine-grade sand used for joints up to 1/8 inch wide; 1:2 for joints up to 1/2 inch wide; 1:3 for joints over 1/2 inch wide; up to one-fifth part lime may be added

C. Dry-set (dry wall) — Mixture of portland cement and additives providing water retentivity

D. Latex-portland cement — Mixture of dry-set, sand-portland cement, or commercial portland cement grout with special latex additive

(NOTE: There are other types of grouts such as mastic, furan resin, epoxy, and silicone rubber, but these materials are usually used by tile setters and not bricklayers.)

XI. Guidelines for mixing and using grout

A. Always follow manufacturer's directions precisely

B. Keep a set of tools just for mixing, a bucket for grout mixture, and a five-gallon bucket for cleanup water

INFORMATION SHEET

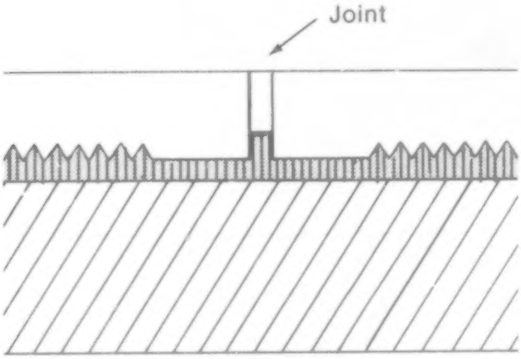
- C. Use cool, potable water
- D. Mix thoroughly to give a uniform consistency
- E. Moisten nonvitreous tiles *before* grout is applied
- F. Damp cure or use latex additive
- G. Always add grout to liquid, *not* liquid to grout
- H. After thorough mixing, wait fifteen minutes before remixing
- I. Fill joints solidly and remove excess grout from face of tile with a good rubber trowel
- J. Strike all joints to make them dense, smooth, and hard

XII. Characteristics of good grouting

- A. Cured hard, smooth, and uniform
- B. Strong and compact to meet normal wear conditions
- C. Finished flush to top of square-edged tile (Figure 2)

EXAMPLE:

FIGURE 2

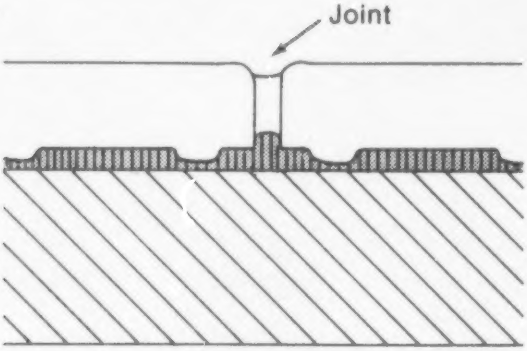


INFORMATION SHEET

D. Tooled or struck to depth of cushion on cushion-edged tile (Figure 2)

EXAMPLE:

FIGURE 3



E. Absence of all grout from face of tile when job is finished

XIII. Reasons for grout discoloration

A. Allowing grout to dry too quickly

B. Applying different depths of grout in the joints

C. Using too much water on freshly grouted areas

D. Acid-cleaning

E. Efflorescence

F. Excessive glaze on edge of tile

G. Inadequate mixing

H. Use of two different batch lots

I. Failure to remove spacers

J. Contamination from dirty tools or materials

XIV. Ways to prevent grout discoloration

A. Follow manufacturer's directions

B. Damp cure or cover grout with kraft paper for seventy-two hours to slow down drying time and to allow grout to dry or cure at an even rate

(NOTE: If latex additive is used, damp curing is not needed.)

INFORMATION SHEET

- C. Mix grout with as little liquid as possible for proper application

  (NOTE: If more than one mix is needed, make each the same in liquid content. Never stop a grout job in the middle of the field or in any conspicuous place.)

- D. Keep excess water off grouted areas

  (CAUTION: Never use a wet sponge for cleanup.)

- E. Keep setting bed materials out of grout joints
- F. Clean only with appropriate cleaners recommended for type of tile used

XV. Special products used in tile installation

- A. Mounted tile — Tile assembled into units or sheets to facilitate handling and installation
- B. Pregrouted ceramic tile sheets — Individual ceramic tiles, factory assembled into pregrouted sheets of various sizes; used for various wall installations
- C. Special-purpose tile — Glazed or unglazed tile having specified physical design or appearance
- D. Prefab panels — Large units (4′ × 10′, 4′ × 8′) of mounted, pregrouted tile; constructed at a plant and delivered to job site ready for installation
- E. Threshold — Transitional piece between two different finished floor levels

XVI. Locations where expansion joints should be used

- A. Walls that abut tile
- B. At curbs
- C. At parapets
- D. Around columns
- E. Around pipes
- F. Around drains
- G. Over expansion, control, and sawed joints in structural walls and floors
- H. Every 12 to 16 feet each way on exterior floors
- I. Where specified

INFORMATION SHEET

XVII. Cleaning methods used prior to setting tile over tile

A. Remove soap scum, wax, oil, and any other coatings from existing surfaces

(NOTE: Cleaning methods may involve use of soapless detergents, commercial tile cleaners, and in special cases, solvents or acid.)

(CAUTION: Solvents and acids should be used with care and only after checking manufacturer's specifications.)

B. Sand surface with carborundum disc, followed with clear water wash

C. Thoroughly rinse and dry area before installing new tile

WALL AND FLOOR TILE
UNIT III

JOB SHEET #1 — INSTALL FLOOR TILE ON CONCRETE BASE

I. Equipment and materials

A. Equipment

1. Mortar box, hoe, and shovel
2. Wheelbarrow
3. Water bucket, water hose
4. Straightedge notched ½ inch on each end
5. Rubber grouting float (floor type)
6. Level
7. Chalk line
8. Rule or tape
9. Pencil
10. Cement trowel and wood float
11. Bricklayer's brush
12. Nylon water brush
13. Tub for soaking tile
14. Claw hammer and nails for building form
15. Framing square
16. Joint spacers
17. Sponges
18. Nylon scouring pad
19. Rubber mallet
20. Beating block
21. Four 2-by-4-inch boards at least 5 feet long

JOB SHEET #1

22. Kraft paper

23. Specifications provided by instructor

24. 5-gallon pail for mixing grout

B. Materials

1. Potable water

2. Portland cement, ASTM C-150, Type 1

3. Sand, ASTM C-144

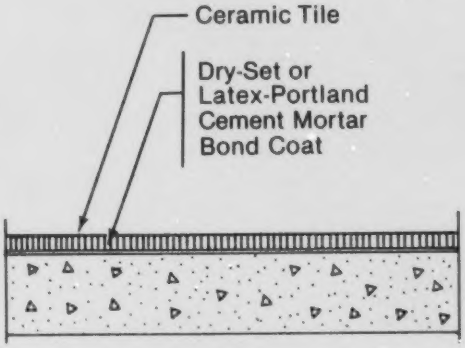
4. Commercial portland cement grout

5. 120 quarry tiles (3 3/4" × 7 3/4" × 7/16")

JOB SHEET #1

Details and Guidelines from TCA *Handbook*

Cement Mortar, Bonded **F101-81**



Recommended Uses:

- exterior floors, decks or patios where membrane is not used and where positive drainage below slab is provided.

Requirements:

- sloped slab required to provide complete surface drainage.
- gravel bed or other means of drainage below slab, is required.
- expansion joints are mandatory.
- cover completed tile work and keep damp for 7 days.

Materials:

- portland cement — ASTM C-150 type 1.
- sand — ASTM C-144.
- water — potable.
- mortar — 1 part portland cement, 6 parts damp sand by volume.
- expansion joints (see Page 28).
- grout — specify type (see Pages 7 & 10).

Preparation by Other Trades:

- provide subsurface drainage.
- slope slab for complete drainage.
- float finish slab, max. variation in the slab shall not exceed 1/4" in 10′ - 0" from the required plane.

Expansion Joint (when specified, shall be detailed by the architect):

- where tile work abuts restraining surfaces such as walls, curbs, parapets, columns, pipes, drains, etc.
- directly over joints in structural floor including construction or cold joints.
- 12′ to 16′ each way in deck; do not exceed 16′ between joints.

Installation Specifications:

- ANSI A108.1.

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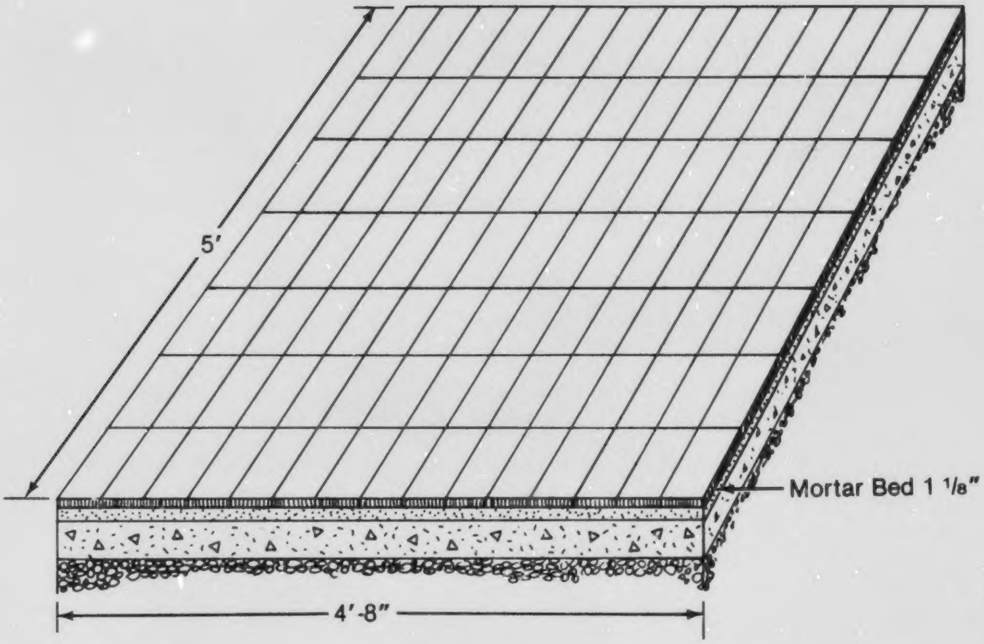
JOB SHEET #1



II. Procedure

A. Lay out project according to specifications

B. Clean base area

C. Build and square form

D. Unbox tile and put it in tub of water to soak

E. Mix mortar using a 1:6 mix

(NOTE: Mortar must be a dry pack mix.)

F. Use shovel to place about one-half of mortar inside form; spread evenly

G. Use wood float, cement trowel, or wood block to compact mortar

H. Place remainder of mortar inside form and spread evenly

I. Use wood float, cement trowel, or wood block to compact mortar

JOB SHEET #1

J. Screed surface of mortar with notched straightedge

(CAUTION: Be sure that mortar is well packed, especially in corners and around edges. Surface must be smooth, flat, and recessed $^{1}/_{2}$ inch from top of two-by-fours.)

K. Sprinkle dry portland cement evenly over surface of mortar about $^{1}/_{16}$ inch thick

(NOTE: Cement will absorb moisture from mortar bed to provide a good bond for the tiles.)

L. Install quarry tiles

(NOTE: For a good bond, be sure that tiles are thoroughly water soaked and damp.)

1. Press and twist each tile into place, maintaining as close to 100 percent coverage as possible on the back of each tile
2. Place spacers between tiles to maintain specified joint width
3. Beat tiles into place with beating block and rubber mallet

   (CAUTION: Care must be taken to avoid breaking tiles.)
4. Sprinkle a small amount of water on mortar bed if cement becomes dry
5. Check alignment and level of tiles as job progresses

   (NOTE: Sometimes it is necessary to lay a large piece of wood on a section of tile and tap it down in order to get all tiles flush with each other.)
6. Clean surfaces of tiles with a damp sponge or nylon scouring pad

   (CAUTION: Care must be taken not to shift the tiles.)

M. Clean tools and area around project

N. Cover floor with kraft paper and allow to damp cure for twenty-four to seventy-two hours

O. Remove spacers

P. Mix grout according to manufacturer's instructions

Q. Grout floor as required for type of tile and width of joint

R. Strike joints if specified

S. Clean work area; put away all materials and equipment

T. Barricade area from traffic for at least twenty-four hours

WALL AND FLOOR TILE
UNIT III

JOB SHEET #2 — INSTALL WALL TILE ON MASONRY WALL

I. Equipment and materials

   A. Equipment

      1. Mortar box, hoe, and shovel
      2. Wheelbarrow
      3. Mortarboard and stand
      4. Water bucket, water hose
      5. Plastering trowel
      6. Hawk
      7. Scarifier
      8. Rubber float
      9. Nylon water brush
      10. Straightedge (notched 1/4" on each end)
      11. Level
      12. Rule or tape
      13. Pencil
      14. Bricklayer's brush
      15. Tub for soaking tile
      16. Claw hammer and masonry nails
      17. Framing square
      18. Sponge
      19. Nylon scouring pad
      20. Rubber mallet
      21. Wood beating block

JOB SHEET #2

22. Margin, pointing, or bucket trowel
23. 5-gallon bucket for mixing grout
24. 1-inch wood ground strips, 4 1/2 feet long
25. Toothbrush to use as striking tool

B. Materials

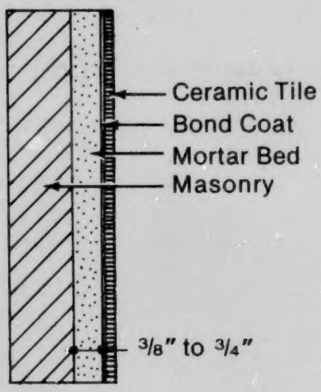
1. Portland cement, ASTM C-150, Type 1
2. Commercial portland cement grout
3. Sand, ASTM C-144
4. Lime, ASTM C-206 or ASTM C-207, Type S
5. 144 wall tiles (4 1/4" x 4 1/4" x 1/4")
6. Potable water
7. Specifications provided by instructor

JOB SHEET #2

Details and Guidelines from TCA *Handbook*

Masonry or Concrete
Cement Mortar, Bonded

W211-81



Recommended Uses:
- over clean, sound, dimensionally stable masonry or concrete.

Limitations:
- do not use over cracked or coated surfaces. Select Method W221 or W222 for such surfaces.

Requirements:
- require a scratch coat over smooth concrete or if surface is irregular or if thickness of mortar bed would exceed 3/4".

Materials:
- portland cement — ASTM C-150 Type 1.
- lime — ASTM C-206 Type S or ASTM C-207 Type S.
- sand — ASTM C-144.
- water — potable.
- scratch coat (for use where thickness of mortar bed exceeds 3/4") — 1 part portland cement, 1/2 part lime, and 4 parts dry sand or 5 parts damp sand; or 1 part portland cement, 3 parts dry sand or 4 parts damp sand.
- mortar bed — 1 part portland cement, 1/2 part lime and 5 parts damp sand to 1 part portland cement, 1 part lime and 7 parts damp sand, by volume.

Materials (Cont.):
- bond coat — portland cement paste. Dry-Set or latex-portland cement mortar permissible with wall tile. (For Dry-Set or latex portland cement mortar on a mortar bed cured for a minimum of 20 hours at 70°F or above, follow Method W213.)
- expansion joints (see Page 28).
- grout — specify type (see Pages 7 & 10).

Preparation by Other Trades:
- surface must be free of coatings, oil, wax.
- all concrete should be bush-hammered or heavily sand-blasted.
- max. variation in the masonry surface shall not exceed 1/4" in 8' - 0" from the required plane.

Expansion Joint (when specified, shall be detailed by the architect):
- directly over all masonry control joints, changes in materials and 24' to 36' elsewhere.

Installation Specifications:
- ANSI A108.1.

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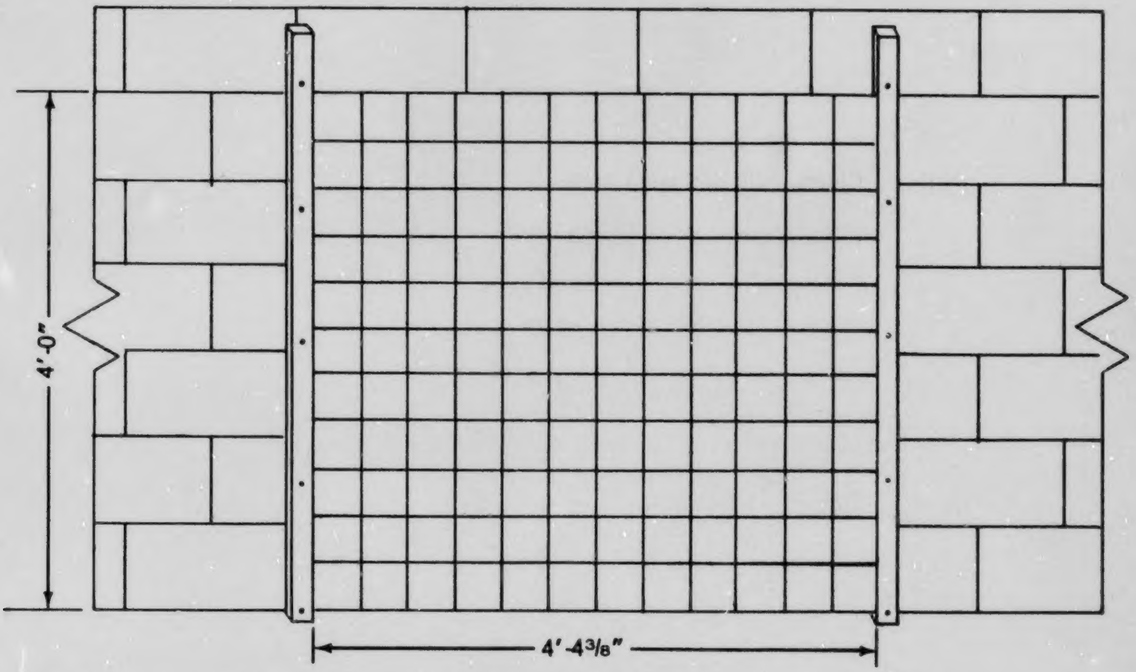
JOB SHEET #2



II. Procedure

A. Lay out project on masonry wall according to specifications

B. Nail ground strips to masonry wall

(NOTE: Be sure that strips are square with floor and plumb.)

C. Mix mortar, using 1:0.50:4 mix

(NOTE: Mortar must be mixed to a workable consistency.)

D. Load mortar into wheelbarrow and move to work area

E. Wet mortarboard

F. Use shovel to transfer mortar from wheelbarrow to mortarboard

G. Load hawk with mortar

H. Apply undercoat

1. Use flat side of plastering trowel to apply first coat of mortar, starting at bottom and working up

   (NOTE: The first coat [undercoat] of mortar should be about ³/₈-inch thick.)

JOB SHEET #2

   2. Continue applying mortar to field until surface is covered uniformly without bare spots

   3. Scratch undercoat with scarifier to provide a rough surface and to assure a good bond between coats

I. Clean tools and work area

J. Allow undercoat to cure at least twenty-four hours before applying second coat

K. Brush surface of undercoat to remove any loose material

L. Mix mortar for second coat, using a 1:0.50:5 mix

M. Load mortar into wheelbarrow and move to work area

N. Wet mortarboard

O. Use shovel to transfer mortar from wheelbarrow to mortarboard

P. Load hawk with mortar

Q. Use water brush to sprinkle wall lightly with water

R. Apply second coat of mortar

   1. Use flat side of plastering trowel to apply second coat of mortar, starting at bottom of wall and working up

   2. Apply enough mortar to fill section of wall to within ¼ inch of face of ground strips

      (NOTE: When applying second coat of mortar to wall, press mortar firmly into first coat to allow a good bond.)

   3. Use notched straightedge to screed and smooth wall surface

   4. Use rubber float to level out any humps, fill voids, and leave a good texture to help bond tile to wall

S. Mix portland cement and water to a creamy consistency

T. Apply tile to wall

(NOTE: Be sure that tile is thoroughly watersoaked and damp.)

   1. Butter back of each tile with margin trowel

JOB SHEET #2

2. Firmly press and twist each tile into place

3. Install tiles in small sections or rows and beat into place with beating block and rubber mallet

   (CAUTION: Care must be taken to avoid breaking tile.)

4. Run margin trowel down or across joints to remove excess bonding material

5. Check alignment and joints as job progresses

   (NOTE: Wall tiles contain factory lugs that automatically provide a $^1/_8$-inch joint when the tiles are butted together.)

6. Clean surfaces of tiles with a clean, damp sponge as job progresses

7. Clean surfaces of tile with damp sponge or scouring pad after all tiles are installed

   (CAUTION: Care must be taken not to shift the tiles.)

U. Clean tools and area around wall

V. Allow tiled area to cure at least seventy-two hours

W. Mix grout according to manufacturer's instructions

X. Grout wall

Y. Strike joints with end of toothbrush handle

Z. Clean work area; put away all materials and equipment

AA. Allow grout to cure for at least twenty-four hours

WALL AND FLOOR TILE
UNIT III

TEST

NAME ____ SCORE ________________

1. Match to their correct definitions terms associated with wall and floor tile. Write the correct numbers in the blanks. Terms and definitions are continued on the following pages.

______a. Characterized by water absorption of more than 0.5 percent, but not more than 3.0 percent

______b. Protective glaze or ornamental facing

______c. Filler material consisting of latex additive and mortar; used to fill uneven spaces during preparation of masonry surface

______d. To compact and smooth grout line with a striking tool

______e. Process that allows tile to take in or absorb moisture

______f. Relating to or dealing with beauty; artistic

______g. To spread a bond coat on the back of a tile just before tile is placed

______h. Very dry mortar mix; mixture is correct when a handful is squeezed and just sticks together without showing any apparent moisture

______i. Residue deposited on the surface of a material by the crystallization of soluble salts

______j. Process used to form tile by forcing plastic clay mixture through an opening of suitable configuration to shape a continuous ribbon of formed clay that is cut to appropriate lengths and widths

______k. Modified portland cement or noncement-based material used for filling joints

______l. Cloudy film that may appear on tiles after grouting

1. Absorption
2. Dry pack
3. Underlayment patching
4. Strike
5. Efflorescence
6. Vitreous
7. Veneer
8. Butter
9. Extrusion process
10. Haze
11. Aesthetic
12. Grout

TEST

______m. Strong paper made from wood pulp processed with sodium sulfate

______n. Able to be penetrated by liquid or vapor

______o. Fit to drink; drinkable

______p. Squared line where tile is to start

______q. Hard dense tile of uniform composition throughout; derives color and texture from materials of which the body is made

______r. Tile, stone, marble, or slate piece used to join floors of different heights; sometimes called a *saddle*

______s. To strike off concrete lying above the desired plane or shape

______t. Reaction in which two or more molecules combine to form a compound containing the same elements in the same proportions, but of higher molecular weight

______u. Water emulsion of synthetic rubber or plastic obtained by polymerization; used in coatings and adhesives

______v. Characterized by water absorption of 0.5 percent or less

______w. Tool used to hold or carry mortar; flat piece of wood or metal with a handle centered and fixed to the underside

______x. Tile with a fused impervious facial finish composed of ceramic materials fused to the body of the tile, which may be nonvitreous, semivitreous, vitreous, or impervious

______y. Gap left between sections of materials to permit expansion or contraction without cracking

13. Potable
14. Adhesive
15. Permeable
16. Bond coat
17. Starting line
18. Ceramic tile
19. Threshold
20. Dust-pressed
21. Unglazed tile
22. Expansion joint
23. Screed
24. Glazed tile
25. Polymerization
26. Hawk
27. Latex
28. Impervious
29. Kraft paper

TEST

______z. Process of forming a tile body by pressing into shape material of low moisture, almost dust-like consistency

______aa. Manufactured tile made essentially from a nonmetallic mineral by firing at high temperatures

______bb. Material used to adhere tile to a prepared surface

______cc. Compound used to bond or stick materials together

2. List seven general areas where tile is used.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

3. State four factors affecting tile selection and installation.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

4. Select from the following list physical characteristics of tile. Write an "X" in the blank before each correct answer.

______a. Impact and pressure proof

______b. Maintenance-free

______c. Acid and alkali resistant

______d. Wear resistant

______e. Waterproof

TEST

______f. Stain resistant

______g. Chemical and bacteria resistant

______h. Abrasion resistant

______i. Freezeproof

______j. Slip resistant (floor type)

______k. Fire resistant

5. Name major types of floor and wall tile. Write the correct names in the blanks.

Type of Tile	Brief Description	Characteristics	Uses
a. ________________	Glazed or unglazed tile made by extrusion process from natural clay or shale; usually has 6 square inches or more of facial area	Excellent wear under hard service conditions	Floors, walls, ceilings, and counter tops; interior or exterior
b. ________________	Glazed tile with a body that is suitable for interior use and which is usually nonvitreous, and is not required nor expected to withstand excessive impact or be subjected to freezing and thawing conditions	Good surface hardness Easy to clean and maintain Fire resistant Chemically resistant to household acids	Interior walls and ceilings; light-duty floors and counter tops
c. ________________	Glazed or unglazed porcelain or natural clay tile formed by the dust-pressed method having 6 square inches or more of facial area	Excellent wear under hard service conditions	Floors, walls, ceilings, and counter tops; interior and exterior
d. ________________	Tile formed by either dust-pressed or plastic method; usually 1/4" to 3/8" thick and having a facial area of less than 6 square inches; may be of either porcelain or natural clay composition, and may be either plain or with an abrasive mixture throughout	Nonstaining Excellent wearing qualities	Floors, walls, ceilings, and counter tops; interior and exterior

TEST

6. Describe types of glazes.

a. Bright — ____

b. Matte — ____

c. Crystalline — ____

____

7. Select from the following list guidelines for layout. Write an "X" in the blank before each correct answer.

______a. If possible, show owner proposed layout before installing tile

______b. If at all possible, center layout at most conspicuous area

______c. Use a plumb bob to square field

______d. Avoid cuts of less than one-half tile

______e. Use actual tiles placed loosely on field

______f. Begin floor tile layout at entrance to room

______g. Square starting lines and compensate for out-of-square field at cuts

______h. Widen joints as necessary to keep tile field square

______i. Double-check all calculations and measurements

8. Select from the following list guidelines for floor and wall installation. Write an "X" in the blank before each correct answer.

______a. Read and follow specifications and plans carefully

______b. When installing floor, use kneeling board if it becomes necessary to work on tiled surface

______c. Inspect area to be tiled

______d. Depress all grouted joints so that they are not flush with surface of tiles

______e. Accurately measure area for tile layout

______f. Avoid using tile cutter or making cuts on tiled area

______g. Always add more water and powder when remixing grout

______h. Avoid putting undue pressure on newly installed tile

TEST

______i. Keep tile joints straight and of even width

______j. Make cuts as small as possible

______k. Clean all surfaces as you go

______l. Install cuts before field

______m. Follow manufacturer's directions carefully with each product

______n. Grout tile as it is installed

______o. When installing floor, work toward exit so that the last tiles are installed at exit

9. Match types of mortars to their correct descriptions. Write the correct numbers in the blanks.

______a. Mixture of portland cement with sand and additives imparting water retentivity; used as a bond coat for setting tile

______b. Mixture of portland cement, sand, and special latex additive; used as a bond coat for setting tile

______c. ASTM C-150, Type 1

1. Portland cement
2. Dry-set mortar
3. Latex-portland cement

10. Match types of grouts to their correct descriptions. Write the correct numbers in the blanks.

______a. Mixture of portland cement and other ingredients to produce a water-resistant, dense, uniformly colored material

______b. On-the-job mixture of one part portland cement to one part fine-grade sand used for joints up to 1/8 inch wide; 1:2 for joints up to 1/2 inch wide; 1:3 for joints over 1/2 inch wide; up to one-fifth part lime may be added

______c. Mixture of portland cement and additives providing water retentivity

______d. Mixture of dry-set, sand-portland cement, or commercial portland cement grout with special latex additive

1. Commercial portland cement
2. Dry-set (dry wall)
3. Sand-portland cement
4. Latex-portland cement

TEST

11. Select from the following list guidelines for mixing and using grout. Write an "X" in the blank before each correct answer.

______a. Keep a set of tools just for mixing, a bucket for grout mixture, and a five-gallon bucket for cleanup water

______b. Mix thoroughly to give a uniform consistency

______c. Use mortar buckets and tools for mixing and applying grout

______d. Use hot or warm water

______e. Always follow manufacturer's directions precisely

______f. Remix grout with water if grout becomes crumbly

______g. Moisten nonvitreous tiles *before* grout is applied

______h. Damp cure or use latex additive

______i. Add powder to liquid after mixing

______j. Use cool, potable water

______k. Always add grout to liquid, *not* liquid to grout

______l. After thorough mixing, wait one-half hour before remixing

______m. Fill joints solidly and remove excess grout from face of tile with a good rubber trowel

______n. Strike all joints to make them dense, smooth, and hard

12. Select from the following list characteristics of good grouting. Write an "X" in the blank before each correct answer.

______a. Finished flush to top of square-edged tile

______b. Rough joints the texture of sandpaper

______c. Tooled or struck to depth of cushion on cushion-edged tile

______d. Cured hard, smooth, and uniform

______e. Soft and powdery

______f. Good color variation

______g. Strong and compact to meet normal wear conditions

TEST

______h. Slight hairline cracks

______i. Absence of all grout from face of tile when job is finished

13. State five reasons for grout discoloration.

a. ____

b. ____

c. ____

d. ____

e. ____

14. Select from the following list ways to prevent grout discoloration. Write an "X" in the blank before each correct answer.

______a. Leave tile spacers in joints

______b. Leave setting bed material in joints

______c. Damp cure or cover grout with kraft paper for seventy-two hours to slow down drying time and to allow grout to dry or cure at an even rate

______d. Mix grout with as little liquid as possible for proper application

______e. Cure by covering with polyethylene

______f. Follow manufacturer's directions

______g. Acid clean

______h. Never acid-clean

______i. Keep setting bed materials out of grout joints

______j. Clean by flooding with water

______k. Keep excess water off grouted areas

______l. Clean only with appropriate cleaners recommended for type of tile used

TEST

15. Match to their correct descriptions special products used in tile installation. Write the correct numbers in the blanks.

______a. Tile assembled into units or sheets to facilitate handling and installation

______b. Large units (4′ × 10′, 4′ × 8′) of mounted, pregrouted tile; constructed at plant and delivered to job site ready for installation

______c. Transitional piece between two different finished floor levels

______d. Individual ceramic tiles, factory assembled into pregrouted sheets of various sizes; used for various wall installations

______e. Glazed or unglazed tile having specified physical design or appearance

1. Pregrouted ceramic tile sheets
2. Prefab panels
3. Mounted tile
4. Threshold
5. Special-purpose tile

16. Select from the following list locations where expansion joints should be used. Write an "X" in the blank before each correct answer.

______a. Around columns

______b. Over masonry joints in structural walls

______c. Every 25 feet each way on exterior floors

______d. Around drains

______e. At curbs

______f. Where specified

______g. Walls that abut tile

______h. At parapets

______i. Around patios and decks

______j. Around pipes

17. Describe cleaning methods used prior to setting tile over tile.

a. ____

____

TEST

b. ______________________________

____

c. ______________________________

____

(NOTE: Test question 18 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

18. Demonstrate the ability to

    a. Install floor tile on concrete base.

    b. Install wall tile on masonry wall.

WALL AND FLOOR TILE
UNIT III

ANSWERS TO TEST

1.

a.	6	i.	5	q.	21	y.	22
b.	7	j.	9	r.	19	z.	20
c.	3	k.	12	s.	23	aa.	18
d.	4	l.	10	t.	25	bb.	16
e.	1	m.	29	u.	27	cc.	14
f.	11	n.	15	v.	28		
g.	8	o.	13	w.	26		
h.	2	p.	17	x.	24		

2. Answer should include any seven of the following

   a. Residential kitchens, bathrooms, and cabinet tops
   b. Commercial kitchens, bathrooms, reception areas, and corridors
   c. Institutional kitchens, bathrooms, dining areas, cabinet tops, and corridors
   d. Hospital kitchens, operating rooms, laboratories, reception areas, and corridors
   e. Food plants
   f. Bottling plants
   g. Packing plants
   h. Breweries
   i. Dairies
   j. Cheese factories
   k. Shopping malls
   l. Receiving and shipping areas
   m. Walks, patios, and decks

ANSWERS TO TEST

3. Answer should include any four of the following
   - a. Cost
   - b. Location
   - c. Physical properties
   - d. Performance characteristics
   - e. Aesthetic value
   - f. Architectural design
   - g. Type, color, size, and texture of tile
   - h. Personal preference

4. c, d, f, g, h, j, k

5. a. Quarry
   - b. Wall
   - c. Paver
   - d. Mosaic

6. Description should include the following
   - a. Bright — High gloss glaze with or without color
   - b. Matte — Low gloss glaze with or without color
   - c. Crystalline — Extra heavy glaze produced for use on counter tops and light-duty floor surfaces where abrasion or impact is not excessive

7. a, b, d, e, g, i

8. a, b, c, e, f, h, i, k, m, o

9. a. 2
   - b. 3
   - c. 1

ANSWERS TO TEST

10.
    a. 1
    b. 3
    c. 2
    d. 4

11. a, b, e, g, h, j, k, m, n

12. a, c, d, g, i

13. Answer should include any five of the following
    a. Allowing grout to dry too quickly
    b. Applying different depths of grout in the joints
    c. Using too much water on freshly grouted areas
    d. Acid-cleaning
    e. Efflorescence
    f. Excessive glaze on edge of tile
    g. Inadequate mixing
    h. Use of two different batch lots
    i. Failure to remove spacers
    j. Contamination from dirty tools or materials

14. c, d, f, i, k, l

15.
    a. 3
    b. 2
    c. 4
    d. 1
    e. 5

16. a, d, e, f, g, h, j

ANSWERS TO TEST

17. Description should include the following
    - a. Remove soap scum, wax, oil, and any other coatings from existing surfaces
    - b. Sand surface with carborundum disc, followed with clear water wash
    - c. Thoroughly rinse and dry area before installing new tile

18. Performance skills evaluated to the satisfaction of the instructor

CLEANING, POINTING, AND CAULKING
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to repair mortar joints, clean masonry, and caulk joints around masonry work. The student will show this knowledge by completing the job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with cleaning, pointing, and caulking to their correct definitions.
2. State reasons for cleaning masonry.
3. State methods used to clean masonry.
4. State guidelines for keeping masonry clean during construction.
5. Label cleaning tools and equipment.
6. Name types of cleaning materials used on masonry.
7. Match types of stains to correct methods for removing them.
8. State safety precautions to follow when cleaning and pointing.
9. State reasons for pointing.
10. Identify tools used to repair masonry.
11. Arrange in order the procedures for pointing.
12. Distinguish between pointing mortar and regular mortar.
13. State reasons for caulking.
14. Name types of sealants.
15. Label tools and equipment used in caulking.
16. Demonstrate the ability to
    a. Repair mortar joints.
    b. Clean brickwork with muriatic acid solution.
    c. Caulk a door frame and a control joint.

CLEANING, POINTING, AND CAULKING
UNIT I

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Obtain transparencies.

      (NOTE: Transparencies are available from AGC and CIMC.)

   B. Gather equipment and materials for job sheet demonstrations.

   C. Provide students with objective sheet.

   D. Discuss unit and specific objectives.

   E. Provide students with information and job sheets.

   F. Discuss information sheet.

   G. Demonstrate and discuss procedures outlined in job sheets.

   H. Advise students to use proprietary cleaning compounds whenever possible in preference to using muriatic acid.

   I. Refer to specifications Part 3.26 and 3.27 in "Basic Plan Reading" for cross reference on pointing, caulking, and cleaning.

   J. Give test.

   K. Complete appropriate section of competency profiles.

      (NOTE: Competency profiles are available from AGC AND CIMC.)

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Transparency master: TM #1 — Caulking Procedures

   E. Job sheets

      1. Job Sheet #1 — Repair Mortar Joints

      2. Job Sheet #2 — Clean Brickwork with Muriatic Acid Solution

      3. Job Sheet #3 — Caulk a Door Frame and a Control Joint

SUGGESTED ACTIVITIES

F. Test

G. Answers to test

III. References

A. Dalzell, J. Ralph. *Simplified Masonry Planning and Building.* New York: McGraw-Hill Book Co., Inc., 1955.

B. Dalzell, J. Ralph, and Gilbert Townsend. *Masonry Simplified*, Vol. I. Chicago: American Technical Society, 1956.

C. *Goldblatt Catalogue: Trowel Trades Tools*. Kansas City, Kansas: Goldblatt Tool Co., 1982.

D. Kreh, R.T. Sr. *Masonry Skills*. Albany, New York: Delmar Publishers, Inc., 1982.

E. Roark, William F., and Harvey C. Plummer. *Bricklaying Vocational Training*. Student Textbook. McLean, Virginia: Brick Institute of America, 1973.

F. *Specification Data: 1-Part Acrylic Terpolymer Sealant*. Cleveland, Ohio: Tremco Manufacturing Co., April 1971.

G. *Tools and Equipment Catalog*. Gibsonia, Pennsylvania: Masonry Specialty Co., 1983.

CLEANING, POINTING, AND CAULKING
UNIT I

INFORMATION SHEET

I. Terms and definitions

- A. Cleaning — Process of removing burrs, stains, efflorescence, and other dirt from finished masonry
- B. Pointing — Process of filling and tooling mortar into a joint after masonry units are laid
- C. Efflorescence — Whitish deposit on exposed surface of masonry; caused by leaching of soluble salts from within masonry
- D. Tuck-pointing — Filling cut-out or defective joints in masonry with fresh mortar
- E. Muriatic acid — Mild solution of hydrochloric acid used for cleaning masonry
- F. Sandblasting — System of cutting or abrading a surface using a stream of sharp sand ejected from a nozzle at high pressure
- G. Striking — Process of tooling mortared joints
- H. Tooling — Finishing mortared joints by compressing mortar with a jointer
- I. Consistency — Relative mobility of fresh mortar, or ability of mortar to flow
- J. Proprietary cleaning compound — Commercial chemical compound used to clean masonry
- K. Manganese stain — Dark stain with an oily look created during the burning process by chemical reactions that result in salts' being deposited on masonry surface
- L. Acetic acid — Colorless, pungent, liquid acid
- M. Hydrogen peroxide — Unstable compound used especially as an oxidizing and bleaching agent
- N. Trisodium phosphate — Water-soluble crystalline compound; used as cleaning compound and water softener
- O. Oxalic acid — Water-soluble acid formed from poisonous, transparent crystals that melt at 187°C; used as a cleaning agent and bleach

INFORMATION SHEET

P. Ammonium bifluoride — Salt that crystallizes in the orthorhombic system and is soluble in water

Q. Hydrofluoric acid — Colorless, aqueous solution of hydrogen fluoride used to clean stone and brick

R. Etch — Eating action or effect of acid on masonry surface; leaves a rough surface

S. Alkali — Soluble salt or mixture of soluble salts present in some soils

T. Emulsifying agent — Dispersing agent; material added to solid-in-liquid or liquid-in-liquid suspensions to separate individually suspended particles

U. Ammonium sulfate — Colorless crystalline salt that melts at 140°C and is soluble in water

V. OSHA — Occupational Safety and Health Act (Public Law 91-596)

W. Sealant — Any of various types of material used to exclude water and foreign materials from joints

X. Thermoplastic — Sealant material that becomes plastic when heated

Y. Elastomer — Elastic substance resembling rubber

Z. Silicone — Polymeric organic silicon compound used as a water-resistant sealant

AA. Acrylic — Synthetic resin used for formulation of caulks and sealants; has very good adhesion and weather-resistant properties

BB. Mastic — Any of various materials composed of asphalts and nondrying oils

CC. Polytremdyne — Polymer mastic for topping or resurfacing concrete floors

DD. Pumice stone — Lightweight volcanic glass (lava) used in powdered form for smoothing and polishing

II. Reasons for cleaning masonry

A. Removing burrs from mortar joints and masonry units

B. Removing mortar and dirt splashed on masonry during construction

C. Removing efflorescence

D. Removing stains

E. Enhancing color of masonry units

INFORMATION SHEET

III. Methods to clean masonry

(NOTE: Keeping the walls clean during construction will help keep the cleaning cost down.)

A. Hand cleaning using cleaning agents

B. Hand cleaning using muriatic acid solution

C. High-pressure water cleaning

D. Chemical and steam cleaning

E. Sandblasting

IV. Guidelines for keeping masonry clean during construction

A. Stock mortar pans and boards far enough from wall to avoid splashing contents on finished wall section

B. Be careful when laying units in wall and when cutting off excess mortar

C. Do not tool joints too soon

(NOTE: Tooling joints too soon causes unnecessary smearing.)

D. Cut off excess mortar after tooling joints

E. Avoid brushing masonry work while mortar is still wet

F. Keep mortar at correct consistency

G. Do not use dirty brushes and tools

H. Avoid any motion that may result in rubbing or pressing mortar into brick face

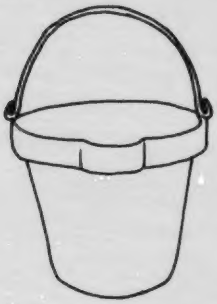
I. Brush finished section of wall thoroughly with a piece of burlap before moving to next section

INFORMATION SHEET

V. Cleaning tools and equipment (Figures 1-11)

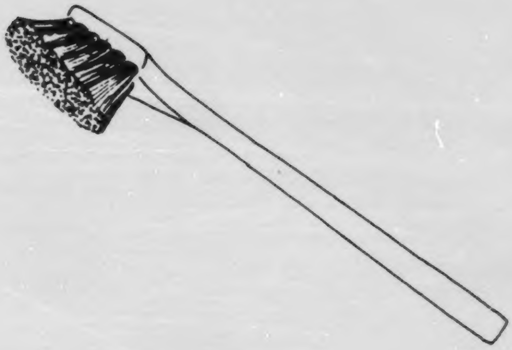
A. Rubber pail

FIGURE 1



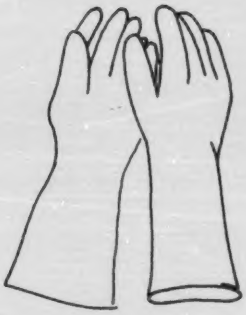
B. Long-handled acid brush

FIGURE 2



C. Rubber gloves

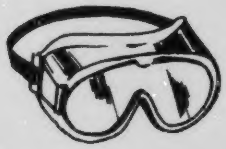
FIGURE 3



INFORMATION SHEET

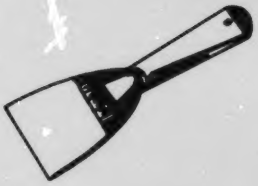
D. Safety goggles

FIGURE 4



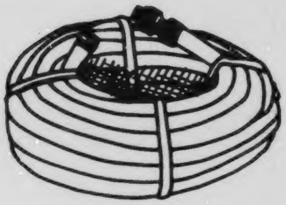
E. Scraper

FIGURE 5



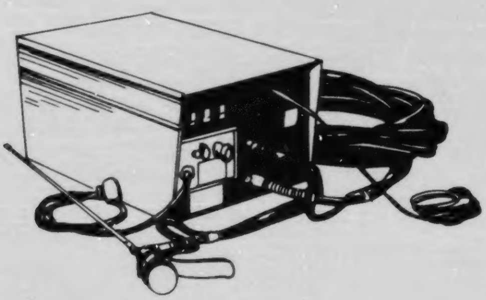
F. Water hose with nozzle

FIGURE 6



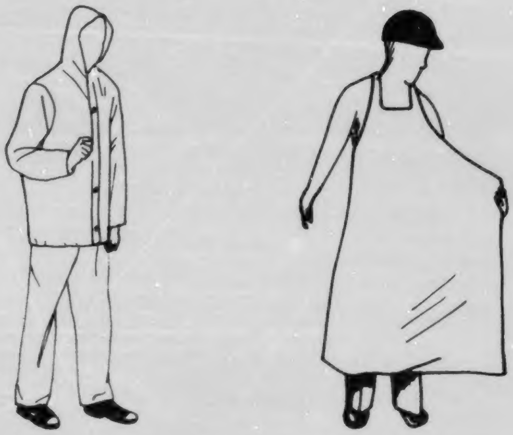
G. High-pressure washer

FIGURE 7



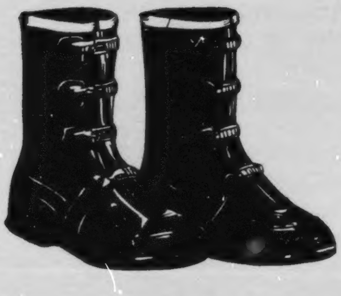
H. Rubber suit or rubber apron

FIGURE 8



I. Overshoes

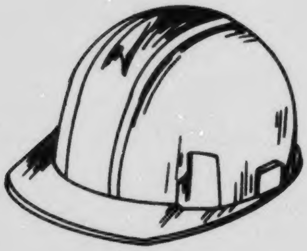
FIGURE 9



INFORMATION SHEET

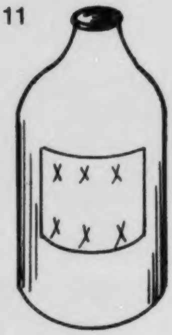
J. Hard hat

FIGURE 10



K. Cleaning agent

FIGURE 11



VI. Types of cleaning materials used on masonry

A. Detergents or soap solutions

(NOTE: These materials are usually used to remove dirt and soil from masonry.)

B. Proprietary cleaning compounds

(NOTE: These compounds are used for cleaning most types of masonry. Consult with supplier for correct compound to use on various types of masonry.)

C. Muriatic acid

(CAUTION: Be very careful when using muriatic acid around aluminum because the combination creates cyanide gas, which is fatal if inhaled. Protect aluminum from muriatic acid.)

INFORMATION SHEET

VII. Methods for removing types of stains

(NOTE: High-pressure steam cleaning and high-pressure washers may aid in the cleaning process for all the following types of stains. The methods and materials mentioned are only a few of the many used to remove stains. Consult with masonry suppliers or chemical companies in your area if in doubt about what to use for a particular type of stain.)

(CAUTION: When in doubt about effects of cleaning compounds, clean a small area and observe the results.)

A. Efflorescence — Hand scrub with clean water or an acetic acid solution mixed no stronger than one part acid to twelve parts water

B. Manganese (brown stain on mortar joint) — Brush or spray with a proprietary cleaning compound or a solution of acetic acid (80 percent or stronger), hydrogen peroxide (30 to 35 percent), and water mixed one part acid, one part peroxide, and six parts water

(CAUTION: Be very careful when mixing this solution; it could cause serious injury.)

(NOTE: Apply this solution with a brush or spray; do not scrub. After chemical reaction takes place, rinse thoroughly with clean water.)

C. Paint (fresh) — Use commercial paint remover or a solution of trisodium phosphate and water mixed 2 pounds phosphate to 1 gallon water

D. Paint (old) — Sandblast

E. Iron (rust) — Spray or brush with strong solution of 1 pound oxalic acid to 1 gallon of water; to speed up reaction, add ½ pound of ammonium bifluoride to solution

(CAUTION: Ammonium bifluoride generates hydrofluoric acid, which may etch the bricks. Maintain extreme caution.)

F. Smoke — Hand scrub with scouring powder or a solution of very strong soap and pumice stone

(NOTE: Some alkaline detergents and commercial emulsifying agents will remove smoke stains, but these usually take more time to work.)

G. Oil and tar — Use commercial emulsifying agents; for heavy tar stains, add kerosene to agent and rinse with clean water

H. Earth or dirt — Use same method as for smoke stains; or if stains are stubborn, use same solution as for iron stains

INFORMATION SHEET

- I. Straw and paper — Apply household bleach and allow to dry

  (NOTE: Quite often, several applications may be necessary to remove stubborn stains.)

- J. Plant growth (such as moss) — Apply ammonium sulfamate according to directions

VIII. Safety precautions to follow when cleaning and pointing

- A. Use plastic or rubber containers for acid solutions

  (NOTE: Acid will react on metal containers.)

- B. Use a long-handled brush for applying acid
- C. Wear protective clothing and safety gear
- D. Avoid skin contact with solutions or inhaling their fumes
- E. Make sure that no one is below you when cleaning
- F. Use only OSHA-approved scaffolds
- G. Follow OSHA regulations for use of swinging scaffolds
- H. Do not throw objects from scaffolds
- I. Check all scaffolds before using them
- J. Use extreme caution when mixing and using acids
- K. Be sure of results of cleaning agents before using them

IX. Reasons for pointing

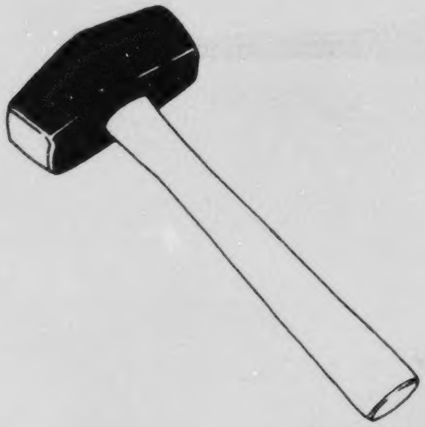
- A. Weatherproofing joints
- B. Waterproofing joints
- C. Enhancing beauty of masonry

INFORMATION SHEET

X. Tools used to repair masonry (Figures 12-21)

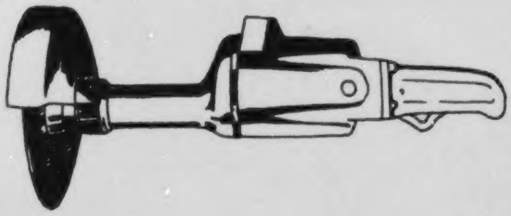
A. Plug or mash hammer

FIGURE 12



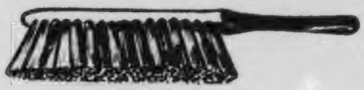
B. Tuck-pointer's grinder

FIGURE 13



C. Soft brush

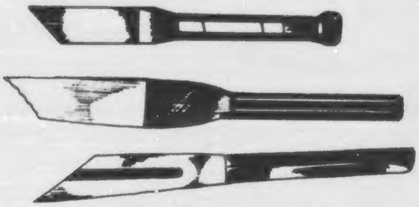
FIGURE 14



INFORMATION SHEET

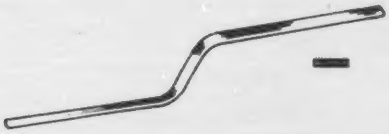
D. Plugging chisels

FIGURE 15



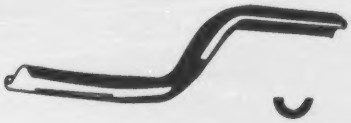
E. Flat jointer

FIGURE 16



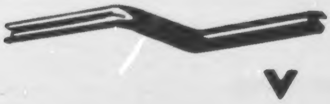
F. Concave jointer

FIGURE 17



G. V-jointer

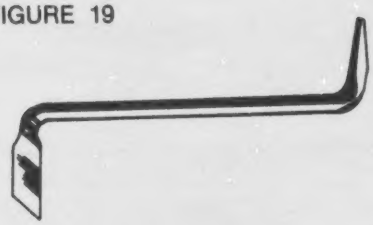
FIGURE 18



INFORMATION SHEET

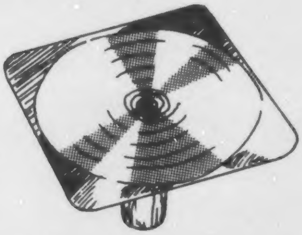
H. Tuck-pointer's rake

FIGURE 19



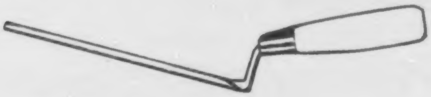
I. Tuck-pointer's hawk

FIGURE 20



J. Caulking or tuck-pointer's trowel

FIGURE 21



XI. Procedures for pointing

A. Mix pointing mortar

(NOTE: Mix mortar before cleaning joint.)

B. Remove mortar from joints to a depth of at least ½ inch

C. Remove dirt and dust from joints

D. Wet joints thoroughly

INFORMATION SHEET

E. Remix mortar, keeping it stiffer than regular mortar

F. Tuck-point mortar into open joints until joints are filled

G. Tool joints when mortar is "thumbprint" set

XII. Pointing mortar and regular mortar

A. Pointing mortar — Portland cement, very fine sand, and lime mixed to a stiff consistency

B. Regular brick mortar — Portland cement, coarse sand, and lime mixed to a consistency that can be handled with a trowel

XIII. Reasons for caulking (Transparency #1)

A. Preventing water penetration around window and door frames

B. Preventing water penetration around masonry perimeters and panels

C. Sealing expansion and control joints

D. Filling joints in precast panels, marble, and slate

XIV. Types of sealants

A. Thermoplastic

B. Elastomer

C. Silicone

D. Acrylic terpolymer

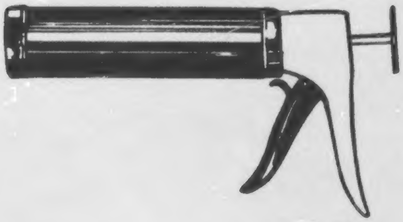
E. Mastic

F. Polytremdyne

XV. Tools and equipment used in caulking (Figures 22-31)

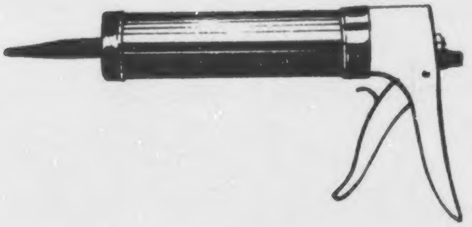
A. Insulated caulking gun

FIGURE 22



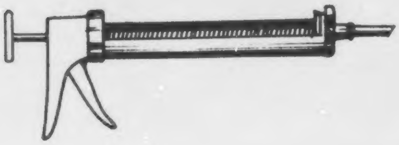
B. Air-pressure caulking gun

FIGURE 23



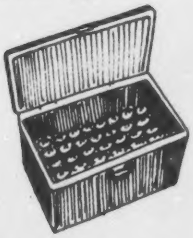
C. Drop-in cartridge caulking gun

FIGURE 24



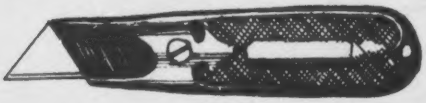
D. Heating chest

FIGURE 25



E. Utility knife

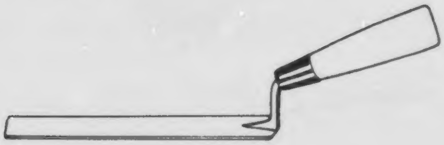
FIGURE 26



INFORMATION SHEET

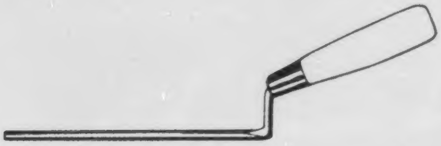
F. Caulking trowel

FIGURE 27



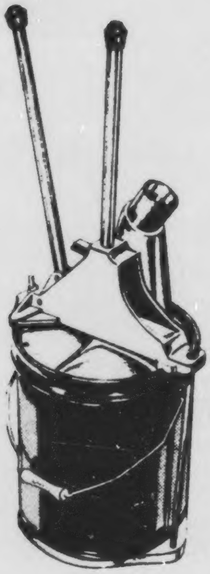
G. Caulking or tuck-pointer's trowel

FIGURE 28



H. Caulking-gun pump (for reloading guns)

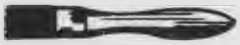
FIGURE 29



INFORMATION SHEET

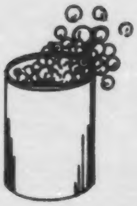
I. Small, soft brush

FIGURE 30

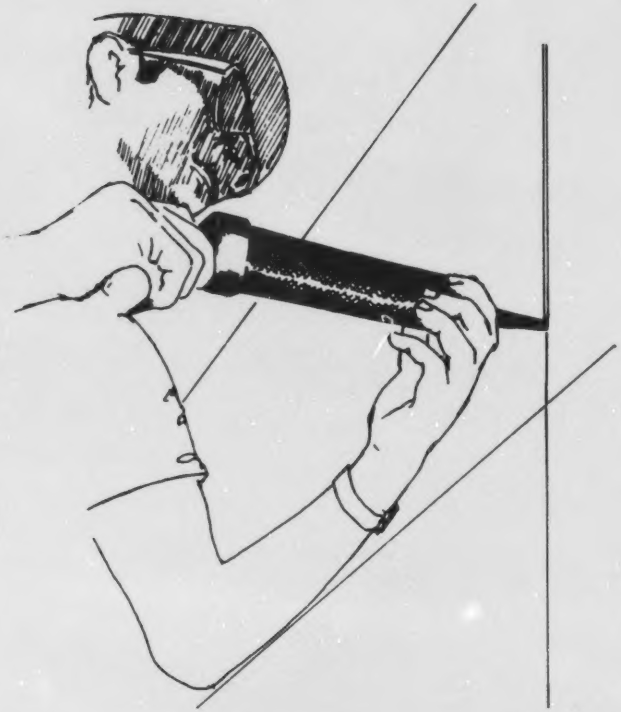


J. Soap solution container

FIGURE 31

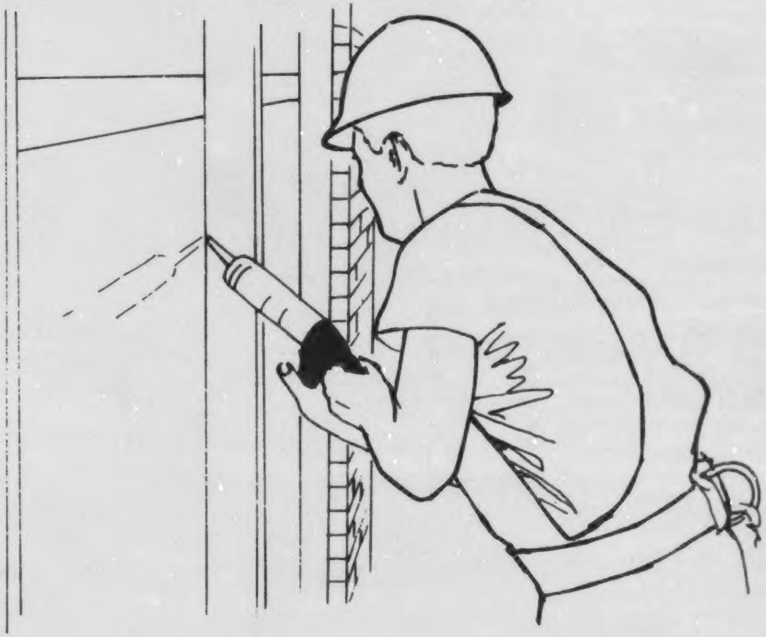


Caulking Procedures



Caulking Control Joint
or Expansion Joint

Perimeter Caulking



CLEANING, POINTING, AND CAULKING
UNIT I

JOB SHEET #1 — REPAIR MORTAR JOINTS

I. Equipment and materials

   A. Tuck-pointer's plugging chisel

   B. Plug or mash hammer

   C. Tuck-pointer's grinder

   D. Flat jointers, assorted sizes

   E. Concave jointers, assorted sizes

   F. Tuck-pointer's hawk

   G. Soft brush

   H. Air compressor

   I. Water hose with nozzle

   J. Fine, sharp sand

   K. Cement

   L. Lime

   M. Safety goggles

   N. Dust mask

   O. Mixing container (mortar tub or bucket)

   P. Brick trowel

II. Procedure

   A. Mix pointing mortar one or two hours before use

   B. Cut out mortar joints to a depth of at least $^1/_2$ inch with hand or power tools

   C. Remove all loose materials with brush, air compressor, or water

   (CAUTION: Always wear eye protection when using compressed air.)

   D. Remix pointing mortar to match existing mortar joints

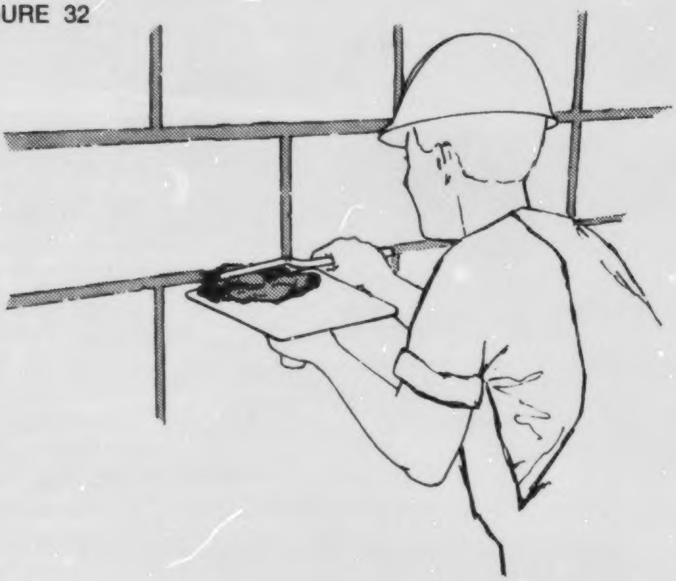
   (NOTE: Remix pointing mortar so that it will not be as wet as brick or block mortar.)

JOB SHEET #1

E. Dampen joints with water spray or brush

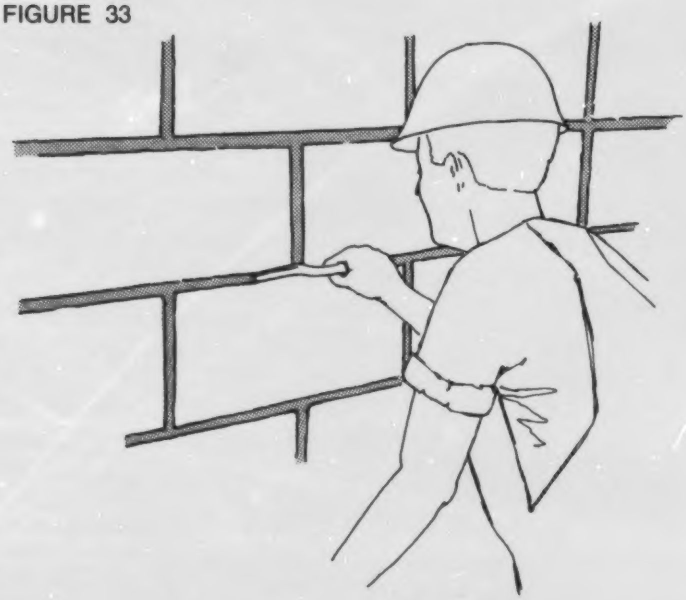
F. Use flat jointer to push mortar in layers into joint until it is filled solid (Figure 32)

FIGURE 32



G. Smooth out filled joints with concave jointer (Figure 33)

FIGURE 33

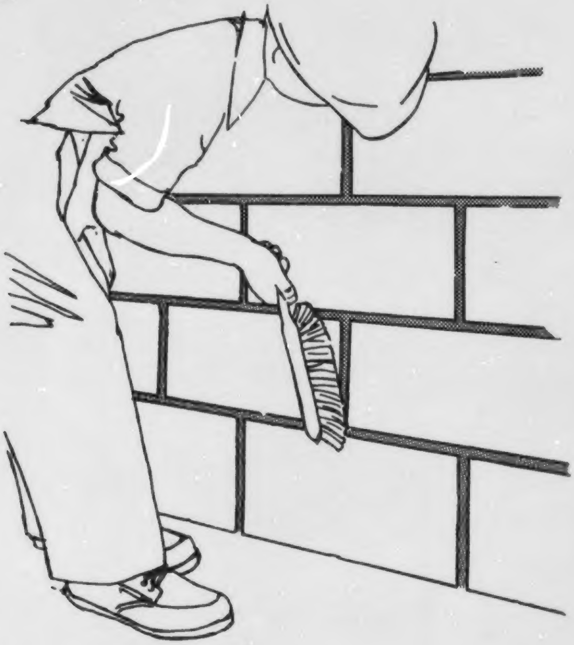


JOB SHEET #1

H. Brush off joints with soft brush to remove any burrs (Figure 34)

(NOTE: Do not stain brick or block facing when tucking mortar into open joints.)

FIGURE 34



I. Clean work area; clean and put away all tools and equipment

CLEANING, POINTING, AND CAULKING
UNIT I

JOB SHEET #2 — CLEAN BRICKWORK WITH MURIATIC ACID SOLUTION

I. Equipment and materials

A. Safety goggles

B. Rubber suit or apron

C. Overshoes

D. Rubber gloves

E. Hard hat

F. Long-handled brush

G. Water hose with nozzle

H. Piece of brick or scraper

I. Masking tape and sheet plastic

J. Rubber pail

K. Muriatic acid solution (one part acid to nine parts clean water)

II. Procedure

(NOTE: As a general rule, allow masonry to cure at least one week [in good weather] before cleaning.)

(CAUTION: Muriatic acid and aluminum create cyanide gas; inhaling this gas can be fatal.)

A. Use masking tape and sheet plastic to cover all metal, glass, wood, limestone, cast stone, and all other materials that may be damaged by acid solution

B. Before wetting down wall, dry-clean wall by using scraper or piece of brick

C. Wash wall down to remove all loose dirt and dust; then presoak wall

(NOTE: Always start from the top and work down.)

D. Scrub wall thoroughly with brush and acid solution

(NOTE: Work about 20 square feet at a time.)

JOB SHEET #2

E. Remove stubborn spots by rubbing wall with a piece of brick, then scrubbing again with acid

F. Rinse wall thoroughly

(CAUTION: Be sure that acid is completely washed off wall, or acid may damage masonry and leave a white scum on the wall.)

G. Move to next area and repeat procedure

H. Continue working from top down and across wall, using same procedures until wall has been completely cleaned

I. Clean work area; clean and put away all tools and equipment

CLEANING, POINTING, AND CAULKING
UNIT I

JOB SHEET #3 — CAULK A DOOR FRAME AND A CONTROL JOINT

I. Equipment and materials

- A. Caulking guns
- B. Heating chest
- C. Door frame
- D. Control joint

II. Procedure for caulking door frame

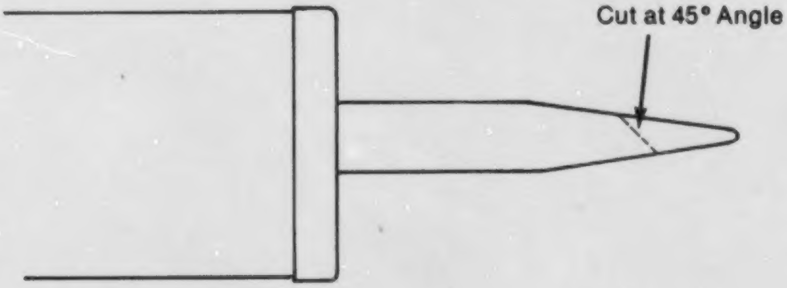
- A. Clean surfaces of door frame and wall

  (NOTE: Make sure that surface is free of dust, oil, grease, wax, or any other foreign material.)

- B. Cut plastic tip of caulking tube at a 45-degree angle (Figure 35)

  (NOTE: Cut angle at point to apply a ¼-inch wide joint.)

FIGURE 35

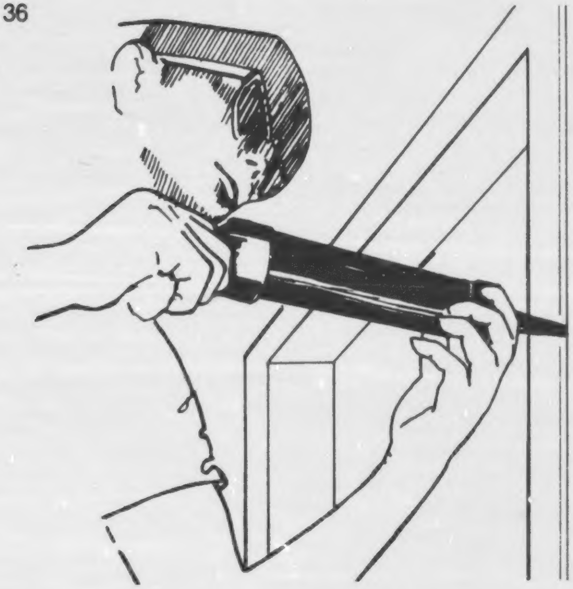


- C. Caulk sides of door frame, starting at top of opening
  1. Hold caulking gun at 45-degree angle and squeeze trigger

JOB SHEET #3

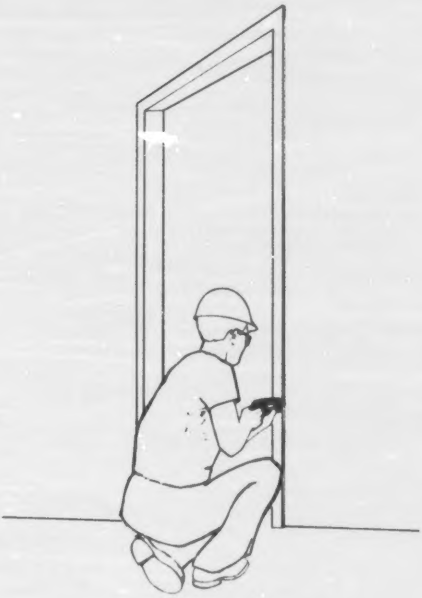
2. Move along joint, keeping ¼-inch thick joint of caulking material at center of tip (Figure 36)

FIGURE 36



3. Draw gun down gradually and smoothly, keeping pressure on trigger until you reach bottom of frame (Figure 37)

FIGURE 37



JOB SHEET #3

4. Repeat procedure on other side of door frame

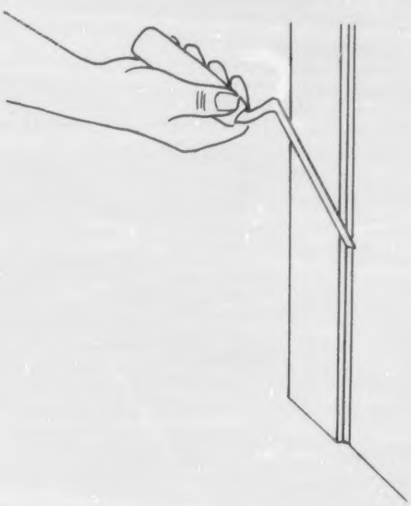
D. Caulk across top of frame

E. Smooth out caulking, using a ¼-inch flat jointer or a ¼-inch caulking trowel dipped in a container of water or soap and water (Figure 38)

(NOTE: A small, fine brush or the tip of the index finger dipped into a soap solution also does a very good job of smoothing the caulking.)

(CAUTION: Do not apply too much pressure with jointer when smoothing caulking materials. Do not let caulk build up on jointer.)

FIGURE 38



F. Clean caulking guns and tools when caulking has been completed

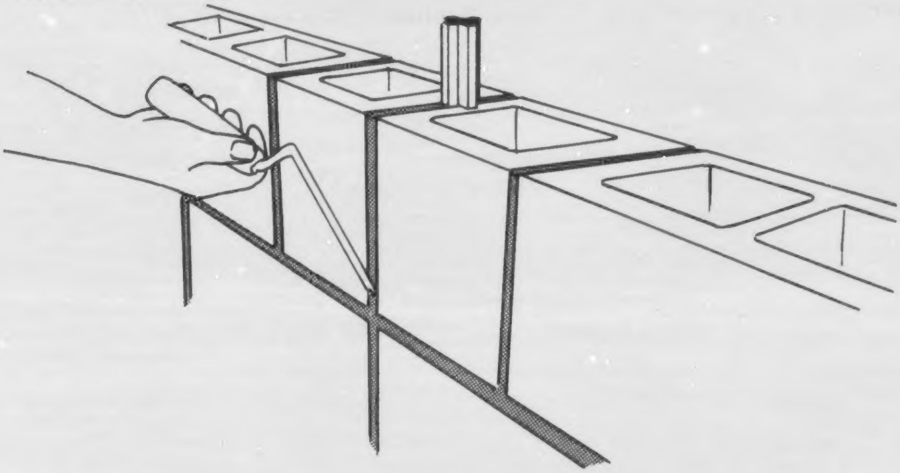
G. Clean work area; clean and put away all tools and equipment

JOB SHEET #3

III. Procedure for caulking control joint

A. Compact control joint with proper backing materials to within ½ inch of face of wall or as called for in specifications (Figure 39)

FIGURE 39



B. Caulk control joint, using same procedure as that used on door frame

C. Hold caulking gun square (at a 90-degree angle) to control joint and keep caulking material flush with face of wall

D. Smooth joint, using same procedure as that used for door frame

E. Clean work area; clean and put away all tools and equipment

CLEANING, POINTING, AND CAULKING
UNIT I

TEST

NAME ____ SCORE ________________

1. Match terms associated with cleaning, pointing, and caulking to their correct definitions. Write the correct numbers in the blanks. Terms and definitions are continued on the following pages.

______a. Process of tooling mortared joints

______b. Colorless, pungent, liquid acid

______c. Mild solution of hydrochloric acid used for cleaning masonry

______d. Elastic substance resembling rubber

______e. Occupational Safety and Health Act (Public Law 91-596)

______f. Sealant material that becomes plastic when heated

______g. Any of various materials composed of asphalts and nondrying oils

______h. Process of filling and tooling mortar into a joint after masonry units are laid

______i. Water-soluble crystalline compound; used as cleaning compound and water softener

______j. Dark stain with an oily look created during the burning process by chemical reactions that result in salts' being deposited on masonry surface

______k. System of cutting or abrading a surface using a stream of sharp sand ejected from a nozzle at high pressure

______l. Colorless crystalline salt that melts at 140°C and is soluble in water

______m. Filling cut-out or defective joints in masonry with fresh mortar

1. Elastomer
2. Tuck-pointing
3. Trisodium phosphate
4. Mastic
5. Sandblasting
6. Muriatic acid
7. OSHA
8. Ammonium sulfate
9. Acetic acid
10. Pointing
11. Thermoplastic
12. Manganese stain
13. Striking

TEST

______n. Relative mobility of fresh mortar, or ability of mortar to flow

______o. Process of removing burrs, stains, efflorescence, and other dirt from finished masonry

______p. Whitish deposit on exposed surface of masonry; caused by leaching of soluble salts from within masonry

______q. Finishing mortared joints by compressing mortar with a jointer

______r. Commercial chemical compound used to clean masonry

______s. Unstable compound used especially as an oxidizing and bleaching agent

______t. Water-soluble acid formed from poisonous, transparent crystals that melt at 187°C; used as a cleaning agent and bleach

______u. Lightweight volcanic glass (lava) used in powdered form for smoothing and polishing

______v. Salt that crystallizes in the orthorhombic system and is soluble in water

______w. Synthetic resin used for formulation of caulks and sealants; has very good adhesion and weather-resistant properties

______x. Colorless, aqueous solution of hydrogen fluoride used to clean stone and brick

______y. Polymeric organic silicon compound used as a water-resistant sealant

______z. Eating action or effect of acid on masonry surface; leaves a rough surface

______aa. Soluble salt or mixture of soluble salts present in some soils

______bb. Dispersing agent; material added to solid-in-liquid or liquid-in-liquid suspensions to separate individually suspended particles

14. Consistency
15. Cleaning
16. Proprietary cleaning compound
17. Acrylic
18. Oxalic acid
19. Silicone
20. Emulsifying agent
21. Efflorescence
22. Etch
23. Pumice stone
24. Polytremdyne
25. Hydrogen peroxide
26. Alkali
27. Hydrofluoric acid
28. Ammonium bifluoride
29. Tooling
30. Sealant

TEST

______cc. Any of various types of material used to exclude water and foreign materials from joints

______dd. Polymer mastic for topping or resurfacing concrete floors

2. State three reasons for cleaning masonry.

a. ______________________________

b. ______________________________

c. ______________________________

3. State three methods used to clean masonry.

a. ______________________________

b. ______________________________

c. ______________________________

4. State five guidelines for keeping masonry clean during construction.

a. ______________________________

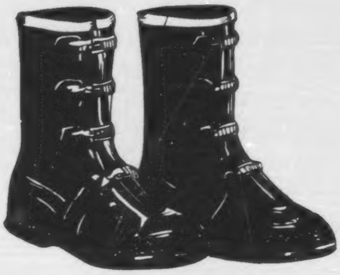
b. ______________________________

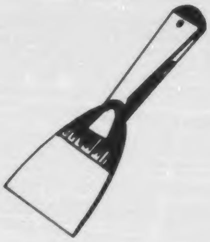
c. ______________________________

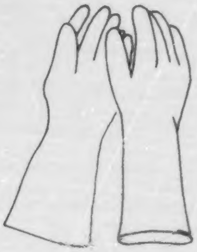
d. ______________________________

e. ______________________________

5. Label the following cleaning tools and equipment.

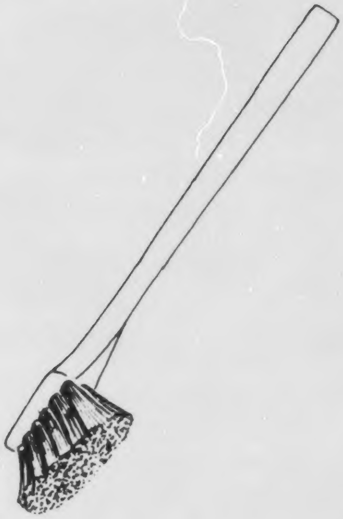


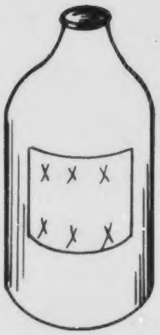


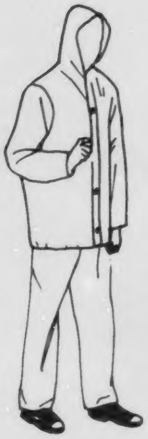


a. ____________ b. ____________ c. ____________

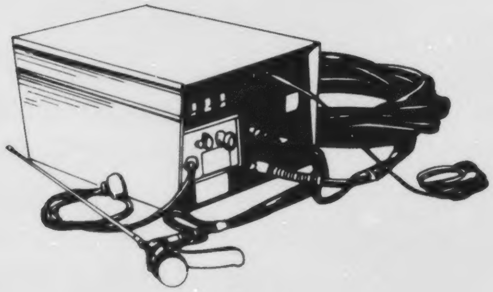
TEST

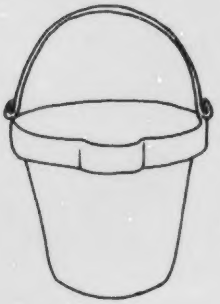






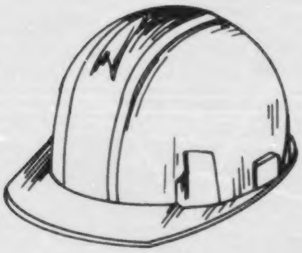
d. ____________________ e. ____________________ f. ____________________

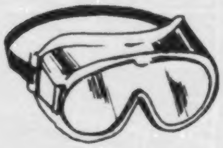


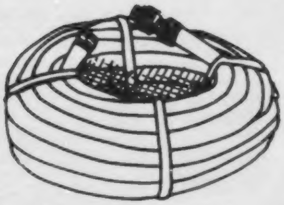


g. ______________________________ h. ______________________________

TEST







i. ____________ j. ____________ k. ____________

6. Name two types of cleaning materials used on masonry.

a. ______________________________

b. ______________________________

7. Match types of stains to correct methods for removing them. Write the correct numbers in the blanks. Some blanks will contain more than one answer.

_____a. Apply ammonium sulfamate according to directions

_____b. Hand scrub with clean water or an acetic acid solution mixed no stronger than one part acid to twelve parts water

_____c. Sandblast

_____d. Brush or spray with a proprietary cleaning compound or a solution of acetic acid (80 percent or stronger), hydrogen peroxide (30 to 35 percent), and water mixed one part acid, one part peroxide, and six parts water

_____e. Spray or brush with strong solution of 1 pound oxalic acid to 1 gallon of water; to speed up reaction, add ½ pound of ammonium bifluoride to solution

_____f. Hand scrub with scouring powder or a solution of very strong soap and pumice stone

_____g. Use commercial paint remover or a solution of trisodium phosphate and water mixed 2 pounds phosphate to 1 gallon water

1. Manganese (brown stain on mortar joint)
2. Smoke
3. Efflorescence
4. Paint (old)
5. Oil and tar
6. Plant growth (such as moss)
7. Paint (fresh)
8. Straw and paper
9. Iron (rust)
10. Earth or dirt

TEST

_____h. Use commercial emulsifying agents; for heavy tar stains, add kerosene to agent and rinse with clean water

_____i. Apply household bleach and allow to dry

_____j. Use same method as for smoke stains; or if stains are stubborn, use same solution as for iron stains

8. State five safety precautions to follow when cleaning and pointing.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

9. State reasons for pointing.

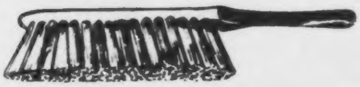
a. ______________________________

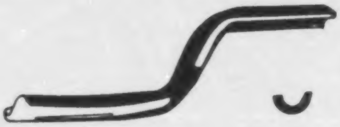
b. ______________________________

c. ______________________________

10. Identify the following tools used to repair masonry. Write the correct names in the blanks.

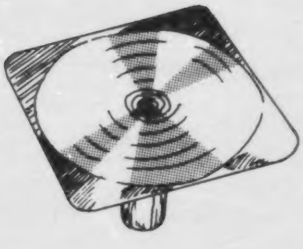
Tuck-pointer's grinder
Tuck-pointer's hawk
Tuck-pointer's rake
Caulking or tuck-pointer's trowel
Soft brush
Flat jointer
V-jointer
Plug or mash hammer
Concave jointer
Plugging chisels



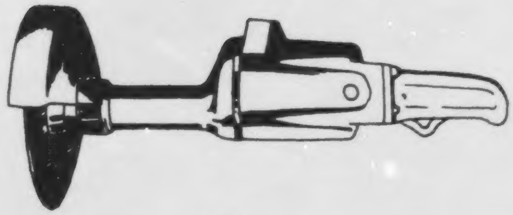


a. ______________________ b. ______________________

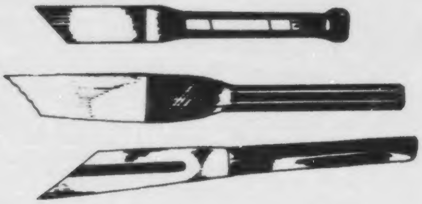
TEST



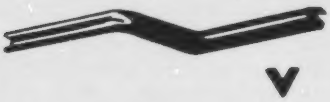
c. ______________________________



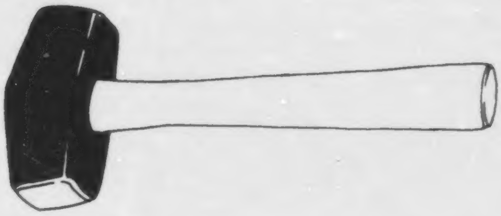
d. ______________________________



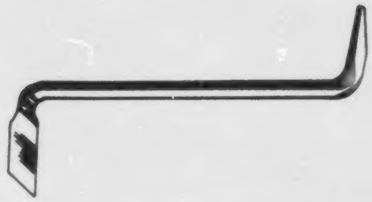
e. ______________________________



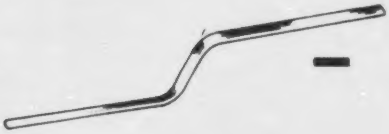
f. ______________________________



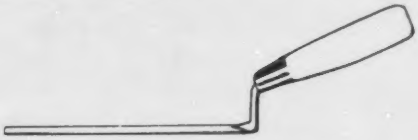
g. ______________________________



h. ______________________________



i. ______________________________



j. ______________________________

TEST

11. Arrange in order the procedures for pointing. Write a "1" before the first step, a "2" before the second step, and so on.

______a. Remove dirt and dust from joints

______b. Tuck-point mortar into open joints until joints are filled

______c. Wet joints thoroughly

______d. Tool joints when mortar is "thumbprint" set

______e. Remove mortar from joints to a depth of at least ½ inch

______f. Remix mortar, keeping it stiffer than regular mortar

______g. Mix pointing mortar

12. Distinguish between pointing mortar and regular mortar. Write a "P" in the blank before pointing mortar and an "R" in the blank before regular brick mortar.

______a. Portland cement, coarse sand, and lime mixed to a consistency that can be handled with a trowel

______b. Portland cement, very fine sand, and lime mixed to a stiff consistency

13. State two reasons for caulking.

a. ______________________________

b. ______________________________

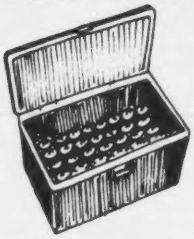
14. Name three types of sealants.

a. ______________________________

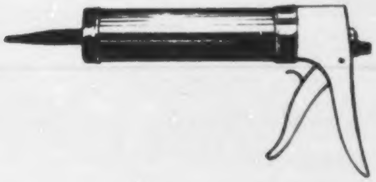
b. ______________________________

c. ______________________________

15. Label the following tools and equipment used in caulking.

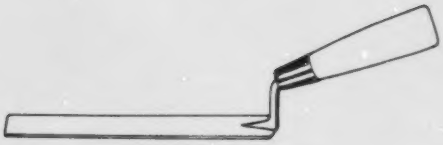


a. ______________________________

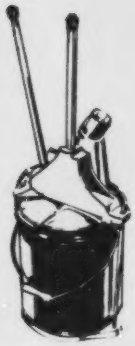


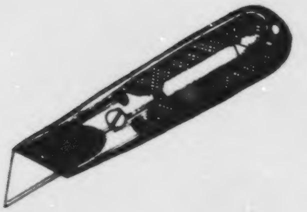
b. ______________________________

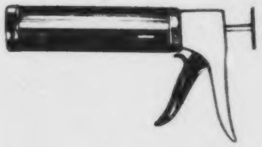
TEST



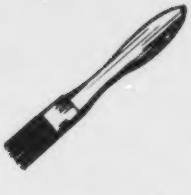
c. ______________________________

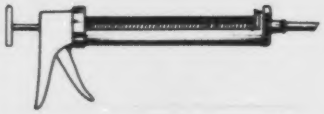


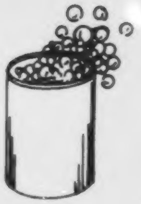




d. ____________________ e. ____________________ f. ____________________

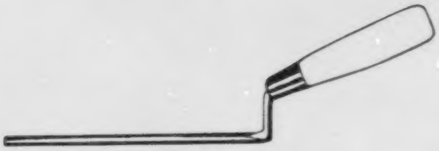






g. ____________________ h. ____________________ i. ____________________

TEST



j. ______________________________

(NOTE: Test question 16 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

16. Demonstrate the ability to

    a. Repair mortar joints.

    b. Clean brickwork with muriatic acid solution.

    c. Caulk a door frame and a control joint.

CLEANING, POINTING, AND CAULKING
UNIT I

ANSWERS TO TEST

1.	a.	13	i.	3	q.	29	y.	19
	b.	9	j.	12	r.	16	z.	22
	c.	6	k.	5	s.	25	aa.	26
	d.	1	l.	8	t.	18	bb.	20
	e.	7	m.	2	u.	23	cc.	30
	f.	11	n.	14	v.	28	dd.	24
	g.	4	o.	15	w.	17		
	h.	10	p.	21	x.	27		

2. Answer should include any three of the following
   a. Removing burrs from mortar joints and masonry units
   b. Removing mortar and dirt splashed on masonry during construction
   c. Removing efflorescence
   d. Removing stains
   e. Enhancing color of masonry units

3. Answer should include any three of the following
   a. Hand cleaning using cleaning agents
   b. Hand cleaning using muriatic acid solution
   c. High-pressure water cleaning
   d. Chemical and steam cleaning
   e. Sandblasting

4. Answer should include any five of the following
   a. Stock mortar pans and boards far enough from wall to avoid splashing contents on finished wall section
   b. Be careful when laying units in wall and when cutting off excess mortar

ANSWERS TO TEST

c. Do not tool joints too soon

d. Cut off excess mortar after tooling joints

e. Avoid brushing masonry work while mortar is still wet

f. Keep mortar at correct consistency

g. Do not use dirty brushes and tools

h. Avoid any motion that may result in rubbing or pressing mortar into brick face

i. Brush finished section of wall thoroughly with a piece of burlap before moving to next section

5. a. Overshoes

b. Scraper

c. Rubber gloves

d. Long-handled acid brush

e. Cleaning agent

f. Rubber suit or rubber apron

g. High-pressure washer

h. Rubber pail

i. Hard hat

j. Safety goggles

k. Water hose with nozzle

6. Answer should include any two of the following

a. Detergents or soap solutions

b. Proprietary cleaning compounds

c. Muriatic acid

7. a. 6

b. 3

c. 4

d. 1

e. 9, 10

f. 2, 10

g. 7

h. 5

i. 8

j. 10

ANSWERS TO TEST

8. Answer should include any five of the following

   a. Use plastic or rubber containers for acid solutions

   b. Use a long-handled brush for applying acid

   c. Wear protective clothing and safety gear

   d. Avoid skin contact with solutions or inhaling their fumes

   e. Make sure that no one is below you when cleaning

   f. Use only OSHA-approved scaffolds

   g. Follow OSHA regulations for use of swinging scaffolds

   h. Do not throw objects from scaffolds

   i. Check all scaffolds before using them

   j. Use extreme caution when mixing and using acids

   k. Be sure of results of cleaning agents before using them

9. Answer should include the following

   a. Weatherproofing joints

   b. Waterproofing joints

   c. Enhancing beauty of masonry

10. a. Soft brush

    b. Concave jointer

    c. Tuck-pointer's hawk

    d. Tuck-pointer's grinder

    e. Plugging chisels

    f. V-jointer

    g. Plug or mash hammer

    h. Tuck-pointer's rake

    i. Flat jointer

    j. Caulking or tuck-pointer's trowel

11. a. 3

    b. 6

    c. 4

    d. 7

    e. 2

    f. 5

    g. 1

ANSWERS TO TEST

12. a. R

    b. P

13. Answer should include any two of the following

    a. Preventing water penetration around window and door frames

    b. Preventing water penetration around masonry perimeters and panels

    c. Sealing expansion and control joints

    d. Filling joints in precast panels, marble, and slate

14. Answer should include any three of the following

    a. Thermoplastic

    b. Elastomer

    c. Silicone

    d. Acrylic terpolymer

    e. Mastic

    f. Polytremdyne

15. a. Heating chest

    b. Air-pressure caulking gun

    c. Caulking trowel

    d. Caulking-gun pump (for reloading guns)

    e. Utility knife

    f. Insulated caulking gun

    g. Small, soft brush

    h. Drop-in cartridge caulking gun

    i. Soap solution container

    j. Caulking or tuck-pointer's trowel

16. Performance skills evaluated to the satisfaction of the instructor

ABL - 47-D

MOISTURE CONTROL AND WATERPROOFING
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to control moisture and waterproof a structure by applying various types of materials. The student will show this knowledge by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with moisture control and waterproofing to their correct definitions.
2. State objectives of moisture control.
3. List types of moisture damage.
4. List sources of moisture damage.
5. State factors that affect amount of moisture and extent of its penetration in masonry.
6. Select from a list trade practices that help waterproof masonry structures.
7. State methods frequently used to control moisture.
8. Match waterproofing materials to their specific uses.
9. Demonstrate the ability to
    a. Apply cement mortar to a foundation wall.
    b. Apply bituminous material to a foundation wall.
    c. Stop a leak, using hydraulic plug.
    d. Apply expansion compound to an exterior wall.
    e. Apply membrane waterproofing to a basement wall, using hot asphalt method.

MOISTURE CONTROL AND WATERPROOFING
UNIT II

SUGGESTED ACTIVITIES

I. Suggested activities

- A. Provide students with objective sheet.
- B. Discuss unit and specific objectives.
- C. Provide students with information and job sheets.
- D. Discuss information sheet.
- E. For cross reference on moisture control and waterproofing, refer to specifications Part 3.17, 3.19, 3.20, and 3.23 in "Basic Plan Reading."
- F. Demonstrate and discuss procedures outlined in job sheets.
- G. Provide equipment and materials necessary to complete procedures outlined in the job sheets.
- H. Give test.
- I. Complete appropriate section of competency profiles.

  (NOTE: Competency profiles are available from AGC and CIMC.)

II. Instructional materials

- A. Objective sheet
- B. Suggested activities
- C. Information sheet
- D. Job sheets
  1. Job Sheet #1 — Apply Cement Mortar to a Foundation Wall
  2. Job Sheet #2 — Apply Bituminous Material to a Foundation Wall
  3. Job Sheet #3 — Stop a Leak, Using Hydraulic Plug
  4. Job Sheet #4 — Apply Expansion Compound to an Exterior Wall
  5. Job Sheet #5 — Apply Membrane Waterproofing to a Basement Wall, Using Hot Asphalt Method

SUGGESTED ACTIVITIES

E. Test

F. Answers to test

III. Unit references

A. Taylor, Merlin, and Harland Randolph. *The Bricklayer: Brick and Block Construction*. Washington, D.C.: International Masonry Apprenticeship Trust, 1977.

B. Turcotte, Raymond J. *Bricklaying Curriculum*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and The Associated General Contractors of America, 1977.

MOISTURE CONTROL AND WATERPROOFING
UNIT II

INFORMATION SHEET

I. Terms and definitions

A. Waterproofing — Process of treating masonry with a material that will prevent penetration of moisture and/or water

B. Penetration — Ability of moisture to enter masonry

C. Capillary — Refers to movement of underground water due to molecular attraction between masonry and water

(NOTE: Capillary capacity is a measure of the ability of surface layers of masonry to hold water against the force of gravity.)

D. Membrane — Layer of thin, pliable material used to waterproof masonry

E. Tuck-point — Fill in or repair masonry joints with fresh mortar

F. Parge — Process of applying cement mortar to masonry

G. Bituminous compounds — Waterproofing agent produced in solid or liquid form from asphalt or coal/tar compounds

H. Hydrostatic pressure — Amount of force exerted against a submerged surface by weight of a liquid

I. Silicone — Any of various polymeric compounds used to seal water from masonry

(CAUTION: Do not use silicone around any petroleum product.)

J. Metallic compound — Combination of clean, commercially pulverized or fine divided cast iron or similar metallic aggregate, and a chemical oxidizing agent

K. Gas-producing grout — Expansive cement containing chemicals that cause cement to expand

L. Elastomer — Elastic substance resembling rubber

M. Dampproofing — Application of materials or treatment of surfaces to retard rather than prevent passage of water

INFORMATION SHEET

II. Objectives of moisture control

(NOTE: Moisture-resistant properties and quality of the masonry work depend largely on bricklayers' skill in installing masonry and waterproofing products so that they act together in controlling and preventing moisture damage.)

A. Prevent water and moisture damage to structure

B. Improve comfort within building

C. Regulate climate within building

D. Control operating cost related to heating, cooling, and maintenance

III. Types of moisture damage

A. Erosion

B. Corrosion

C. Defacement

D. Lower material performance

IV. Sources of moisture damage

A. Penetration below grade

B. Penetration above grade

C. Interior entrapment

D. Capillary movement of moisture

V. Factors that affect amount of moisture and extent of its penetration in masonry

A. Relative humidity

B. Temperature

C. Water pressure

VI. Trade practices that help waterproof masonry structures

A. Lay units with solid, full, compact joints

B. Install flashings, membranes, copings, and other construction details according to specifications

INFORMATION SHEET

C. Prepare surface for proper bonding and coverage

D. Make waterproofing treatment complete and unbroken

E. Apply materials only when temperature is within specified range

F. Apply treatment to correct location, usually between source of moisture and surface to be protected

G. Follow manufacturer's recommendations and specifications for application of specific materials

VII. Methods frequently used to control moisture

(NOTE: Moisture control is achieved by a combination of proper design, materials, and construction procedures. A good moisture control must be able to deal with elements such as pressure, wind, rain, temperature, and humidity.)

A. Install drainage systems

B. Apply waterproofing treatment and/or waterproofing systems

C. Apply dampproofing treatment

D. Install vapor barriers

E. Install capillary controls

VIII. Waterproofing materials and their specific uses

(CAUTION: Prepare and apply all waterproofing materials according to specifications and instructions for specific types.)

A. Portland cement mortar — Used to tuck-point joints, and plaster or parge walls

B. Bituminous compounds — Used on masonry wall or over coatings of portland cement mortar; applied by spraying, brushing, or troweling directly to surface, usually on exterior of wall

(NOTE: Regardless of how material is applied, a cove is necessary at the base of wall to provide a runoff for water.)

(CAUTION: Be sure there is no break, crack, or opening in the coating. If water penetrates the smallest hole, hydrostatic pressure will enlarge the opening and defeat the purpose.)

INFORMATION SHEET

C. Sealants (silicone) — Used mostly on vertical walls; applied by spraying or brushing on exterior wall

(CAUTION: Do not use silicone around any petroleum product.)

(NOTE: After silicone cures, it provides a durable, invisible film that is water repellent; it allows interior moisture to evaporate, but does not alter the appearance of the masonry.)

D. Expanding compounds — Used to fill cracks and pores; materials expand when properly applied to interior or exterior surface

(NOTE: Expanding compounds such as metallic compounds, gas-producing grout and expansive cements have excellent bonding characteristics and are easy to use.)

E. Membrane waterproofing: hot asphalt or tar combined with a fabric — Used generally on exterior surface below grade

(NOTE: The fabric is available in sheets or rolls.)

F. Membrane waterproofing: cold process — Used above or below grade, depending on type; lead, copper, rubber, plastic, and elastomers are secured to surface by adhesive, emulsion, pressure, or fastening devices

(NOTE: Cold process types of membrane waterproofing are available in sheets or rolls.)

G. Membrane waterproofing: liquid membrane — Used on interior or exterior surface, above or below grade; applied with trowel, brush, squeegee, or spray gun

MOISTURE CONTROL AND WATERPROOFING
UNIT II

JOB SHEET #1 — APPLY CEMENT MORTAR TO A FOUNDATION WALL

I. Equipment and materials

   A. Brick trowel

   B. Tuck-pointer's hawk

   C. Scarifier

   D. Water hose and nozzle

   E. Mortarboard or tub

   F. Cement mortar

II. Procedure

   A. Clean surface of wall

   B. Wash down wall

   C. Fill all cracks and voids larger than 1/4 inch before parging wall

   D. Apply mortar and shape into a cove at the junction of foundation wall and footing

   (NOTE: This cove will help the water drain away from the structure.)

   E. Apply about 1/4 inch of mortar at base of wall, forcing mortar onto surface to form a good bond

   (NOTE: Start at the cove at the bottom of wall and work up the wall.)

   F. Spray a fine mist of water on surface as work progresses

   G. Continue applying mortar about 1/4 inch thick to wall until wall has been completely parged

   (NOTE: Lap sections of the coat so that edges of the upper section extend over lower section.)

   H. Use scarifier to roughen surface of mortar as first coat sets

   (NOTE: Roughening wall will provide a good bond for second coat of mortar.)

JOB SHEET #1

I. Allow mortar to set, usually twelve to twenty-four hours

J. Apply second coat of mortar to wall, using same procedures as above

K. Keep wall damp until mortar cures

L. Have instructor evaluate wall

M. Clean work area; clean and put away all tools and equipment

MOISTURE CONTROL AND WATERPROOFING
UNIT II

JOB SHEET #2 — APPLY BITUMINOUS MATERIAL TO A FOUNDATION WALL

(NOTE: Bituminous material will be applied to a wall previously coated with a cement mortar.)

I. Equipment and materials

A. Stiff fiber brush

B. Heavy-duty cloth or glass fiber material

(NOTE: This fiber will be used as a waterproofing reinforcement on the sharp corners because the corners cannot be covered adequately by a bituminous material.)

C. Primer

D. Bituminous material

(NOTE: Manufacturer will recommend type of primer to use, methods of application, coverage of material [usually stated in terms of gallons per 100 square feet], and time period between coat applications.)

II. Procedure

(NOTE: General procedures for hot and cold bituminous materials are relatively similar except that hot material is usually applied with a mop, while cold material is applied with a brush or a trowel.)

A. Apply primer to entire area to be coated, use brush to work material into the wall surface

B. Allow primer to dry as specified by manufacturer

C. Apply first coat of bituminous material, starting at cove and working up wall

(NOTE: Apply first coat in a vertical or horizontal direction and second coat in the opposite direction, reducing chances of breaks or cracks. Remember to lap upper sections over lower sections.)

D. Continue brushing material on wall, keeping thickness constant until wall is complete

E. After applying a coat to the corners, embed reinforcement fiber into material, covering sharp corner

JOB SHEET #2

F. Allow first coat to dry as specified by manufacturer

G. Apply second coat, using same procedures as above, except that second coat will be applied at right angle to first coat

(CAUTION: When backfilling foundation wall, maintain extreme caution to avoid scratching or breaking the bituminous material. Sometimes manufacturers specify a protective coating.)

H. Have instructor evaluate wall

I. Clean work area; clean and put away all tools and equipment

MOISTURE CONTROL AND WATERPROOFING
UNIT II

JOB SHEET #3 — STOP A LEAK, USING HYDRAULIC PLUG

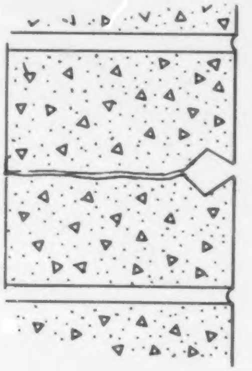
I. Equipment and materials

- A. Hammer
- B. Chisel
- C. Brushes, 1-inch fine and medium size fiber
- D. Tuck-point or caulking trowel
- E. Short length of $\frac{3}{8}$- or $\frac{1}{2}$-inch pipe
- F. Commercial type bonding agent
- G. Commercial type hydraulic cement
- H. Margin trowel

II. Procedure

- A. Chip out crack to an inverted *v* (Figure 1)

FIGURE 1



(NOTE: Keep crack as small as possible, approximately $\frac{1}{2}$ inch deep by $\frac{1}{2}$ inch wide.)

- B. Cut a hole at bottom of crack large enough to hold pipe
- C. Use fiber brush to clean all loose material and dust from crack
- D. Insert pipe into hole
- E. Apply bonding agent to the crack, using the small brush

(NOTE: Follow manufacturer's recommendations when using bonding agent.)

JOB SHEET #3

F. Use margin trowel to mix hydraulic cement according to specifications

(NOTE: Do not mix more cement than can be used in a very short time; most hydraulic cements set in three to twelve minutes.)

G. Fill crack, starting at top and work down

H. Press hydraulic cement firmly into crack to assure good bond

I. Continue filling until crack is completely filled down to pipe

J. Allow hydraulic cement to set and seal crack

(NOTE: Be sure crack is filled flush with outer surface of wall.)

K. Mix enough hydraulic cement to form a round plug large enough to fit hole after pipe is removed

L. Remove pipe with a twisting motion so that adjoining patch is not damaged

M. Press plug firmly into hole and hold in place until plug has set

(NOTE: As hydraulic cement sets, it will expand and seal the hole.)

N. After leak has been patched and sealed, mix and apply a slurry coat over entire area that has been repaired

(NOTE: Slurry may be mixed with cement and water to the consistency of thick cream.)

O. Have instructor evaluate repaired area

P. Clean work area; clean and put away all tools and equipment

MOISTURE CONTROL AND WATERPROOFING
UNIT II

JOB SHEET #4 — APPLY EXPANSION COMPOUND TO AN EXTERIOR WALL

I. Equipment and materials

  A. Fiber brush

  B. Water hose, nozzle, and bucket

  C. Expansion compound

  (NOTE: Manufacturer will specify proper applications, mixing procedures and consistency, temperature and climatic conditions, coverage, and priming.)

  D. Bucket for mixing

  E. Margin trowel

II. Procedure

  A. Clean wall thoroughly

  B. Wet entire wall with water hose

  C. Use margin trowel to mix primer coat to a creamy consistency, using compound and water

  D. Apply primer to entire wall, using brush with a rotary motion, starting at top of wall on one end and working down

  E. Allow primer to dry as specified

  F. Mix expansion compound as specified

  G. Apply first coat of material to surface of wall, keeping surface moist as work progresses

  (NOTE: Occasionally dip the brush into water bucket to clean off dry material.)

  H. Continue applying material from one end of wall to opposite end until entire wall has been covered

  I. Keep surface damp for twenty-four hours or as specified

JOB SHEET #4

J. Allow material to dry as specified

K. Use margin trowel to mix expansion compound for finish coat as specified

(NOTE: Usually finish coat can be mixed slightly thinner than first coat.)

L. Apply finish coat to wall surface, following above procedures

M. Follow manufacturer's recommendations for curing finish coat

N. Have instructor evaluate wall

O. Clean work area; clean and put away all tools and equipment

MOISTURE CONTROL AND WATERPROOFING
UNIT II

JOB SHEET #5 — APPLY MEMBRANE WATERPROOFING TO A BASEMENT WALL, USING HOT ASPHALT METHOD

(NOTE: This application includes a mortar coat; a primer coat; several coatings of hot asphalt; several plies of cloth, felt, or glass mesh; and in some cases, a protective covering.)

I. Equipment and materials

  A. Trowel

  B. Mop or long-handled brush

  C. Tuck-pointer's hawk

  D. Scarifier

  E. Water hose and nozzle

  F. Mortarboard or tub

  G. Cement mortar

  H. Hot asphalt

  I. Fabric membrane

  J. Utility knife

II. Procedures

  A. Apply mortar coat (Job Sheet #1)

  B. Apply hot asphalt and membrane

    1. Apply primer as specified

    2. Cover surface completely and uniformly

    3. Allow specified drying time

    4. Apply first mop coat of asphalt, maintaining an even thickness over entire surface

    5. Embed first layer of fabric membrane into asphalt

    (NOTE: Embed fabric in asphalt that is still soft and pliable; overlap adjacent layers 8 to 12 inches.)

JOB SHEET #5

6. Use brush or smooth block to press membrane into asphalt without causing buckles or wrinkles

7. Use sufficient pressure to embed membrane, forcing asphalt through and around strands of fabric

8. Cut fabric evenly where necessary, such as at junctions and openings

9. Seal all laps with additional coating of asphalt

10. Repeat procedures to apply second coat of asphalt, maintaining even thickness until entire surface is covered

    (NOTE: Be sure to maintain specified thickness of material because the two layers of fiber must not touch.)

11. Embed second layer of fabric into asphalt, following same procedures as above

12. Apply second layer of fabric so that it overlaps first layer by 8 to 12 inches

    (NOTE: If at all possible, no joints in any two layers should be directly on top of one another.)

13. Repeat procedures to apply asphalt and fiber until reaching specified number of layers

14. Apply final coat of asphalt, maintaining specified thickness and care so that no fabric is exposed

15. Inspect entire wall before backfilling to be sure there are no breaks, cracks, or other damage

16. Backfill cautiously

    (NOTE: Sometimes a protective course is specified.)

C. Have instructor evaluate waterproofing

D. Clean work area; clean and put away all tools and equipment

MOISTURE CONTROL AND WATERPROOFING
UNIT II

TEST

NAME ____ SCORE ________________

1. Match terms associated with moisture control and waterproofing to their correct definitions. Write the correct numbers in the blanks.

______a. Ability of moisture to enter masonry

______b. Process of applying cement mortar to masonry

______c. Elastic substance resembling rubber

______d. Fill in or repair masonry joints with fresh mortar

______e. Layer of thin, pliable material used to waterproof masonry

______f. Expansive cement containing chemicals that cause cement to expand

______g. Waterproofing agent produced in solid or liquid form from asphalt or coal/tar compounds

______h. Process of treating masonry with a material that will prevent penetration of moisture and/or water

______i. Any of various polymeric compounds used to seal water from masonry

______j. Combination of clean, commercially pulverized or fine divided cast iron or similar metallic aggregate, and a chemical oxidizing agent

______k. Amount of force exerted against a submerged surface by weight of a liquid

______l. Refers to movement of underground water due to molecular attraction between masonry and water

______m. Application of materials or treatment of surfaces to retard rather than prevent passage of water

1. Tuck-point
2. Hydrostatic pressure
3. Silicone
4. Gas-producing grout
5. Capillary
6. Penetration
7. Dampproofing
8. Metallic compound
9. Membrane
10. Parge
11. Bituminous compounds
12. Elastomer
13. Waterproofing

TEST

2. State three objectives of moisture control.

a. ______________________________

b. ______________________________

c. ______________________________

3. List three types of moisture damage.

a. ______________________________

b. ______________________________

c. ______________________________

4. List three sources of moisture damage.

a. ______________________________

b. ______________________________

c. ______________________________

5. State two factors that affect amount of moisture and extent of its penetration in masonry.

a. ______________________________

b. ______________________________

6 Select from the following list trade practices that help waterproof masonry structures. Write an "X" in the blank before each correct answer.

______a. Lay solid units without joints

______b. Follow manufacturer's recommendations and specifications for application of specific materials

______c. Prepare surface for proper bonding and coverage

______d. Apply materials only when temperature is high so that it will dry fast

______e. Always apply treatment to exterior so that moisture does not get to masonry

______f. Install flashings, membranes, copings, and other construction details according to specifications

______g. Make waterproofing treatment complete and unbroken

TEST

7. State three methods frequently used to control moisture.

a. ______________________________

b. ______________________________

c. ______________________________

8. Match waterproofing materials to their specific uses. Write the correct numbers in the blanks.

_____a. Used mostly on vertical walls; applied by spraying or brushing on exterior wall

_____b. Used on masonry wall or over coatings of portland cement mortar; applied by spraying, brushing, or troweling directly to surface, usually on exterior of wall

_____c. Used to fill cracks and pores; materials expand when properly applied to interior or exterior surface

_____d. Used on interior or exterior surface, above or below grade; applied with trowel, brush, squeegee, or spray gun

_____e. Used above or below grade, depending on type; lead, copper, rubber, plastic, and elastomers are secured to surface by adhesive, emulsion, pressure, or fastening devices

_____f. Used to tuck-point joints, and plaster or parge walls

_____g. Used generally on exterior surface below grade

1. Bituminous compounds
2. Membrane waterproofing: cold process
3. Expanding compounds
4. Sealants (silicone)
5. Membrane waterproofing: hot asphalt or tar combined with a fabric
6. Membrane waterproofing: liquid membrane
7. Portland cement mortar

(NOTE: Test question 9 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

9. Demonstrate the ability to

a. Apply cement mortar to a foundation wall.

b. Apply bituminous material to a foundation wall.

c. Stop a leak, using hydraulic plug.

d. Apply expansion compound to an exterior wall.

e. Apply membrane waterproofing to a basement wall, using hot asphalt method.

MOISTURE CONTROL AND WATERPROOFING
UNIT II

ANSWERS TO TEST

1. a. 6
   b. 10
   c. 12
   d. 1
   e. 9
   f. 4
   g. 11
   h. 13
   i. 3
   j. 8
   k. 2
   l. 5
   m. 7

2. Answer should include any three of the following
   a. Prevent water and moisture damage to structure
   b. Improve comfort within building
   c. Regulate climate within building
   d. Control operating cost related to heating, cooling, and maintenance

3. Answer should include any three of the following
   a. Erosion
   b. Corrosion
   c. Defacement
   d. Lower material performance

4. Answer should include any three of the following
   a. Penetration below grade
   b. Penetration above grade
   c. Interior entrapment
   d. Capillary movement of moisture

ANSWERS TO TEST

5. Answer should include any two of the following
   - a. Relative humidity
   - b. Temperature
   - c. Water pressure

6. b, c, f, g

7. Answer should include any three of the following
   - a. Install drainage systems
   - b. Apply waterproofing treatment and/or waterproofing systems
   - c. Apply dampproofing treatment
   - d. Install vapor barriers
   - e. Install capillary controls

8.

a.	4	e.	2
b.	1	f.	7
c.	3	g.	5
d.	6		

9. Performance skills evaluated to the satisfaction of the instructor